REPORT RESUMES

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A STUDY OF THE RE-EMPLOYMENT AND UNEMPLOYMENT EXPERIENCES OF SCIENTISTS AND ENGINEERS LAID OFF FROM 62 AEROSPACE AND ELECTRONICS FIRMS IN THE SAN FRANCISCO BAY AREA DURING 1963-65. FINAL REPORT.

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DESCRIPTORS- *JOB LAYOFF, *SCIENTISTS, *ENGINEERS, *ELECTRONICS INDUSTRY, *AEROSPACE INDUSTRY, EMPLOYMENT EXPERIENCE, ELECTRONICS, JOB APPLICATION, JOB TENURE, FINANCIAL PROBLEMS, INDIVIDUAL CHARACTERISTICS, UNEMPLOYMENT, EMPLOYMENT PROBLEMS, MANPOWER UTILIZATION, EMPLOYMENT PRACTICES, EDUCATIONAL BACKGROUND, MIGRATION, CALIFORNIA, SAN FRANCISCO,

THE PURPOSE OF THIS STUDY WAS (1) TO ANALYZE SELECTED ASPECTS OF UNEMPLOYMENT AND REEMPLOYMENT EXPERIENCES OF 1,184 ENGINEERS AND SCIENTISTS WHO WERE PERMANENTLY LAID OFF BY 62 DEFENSE-ORIENTED AEROSPACE AND ELECTRONICS COMPANIES DURING AN 18-MONTH PERIOD ENDING MARCH 31, 1965, AND (2) TO DESCRIBE THE MAGNITUDE OF THE SAN FRANCISCO BAY AREA'S SCIENTIFIC AND ENGINEERING UNEMPLOYMENT PROBLEM. IDENTIFICATION OF THOSE LAID OFF WAS MADE FROM PERSONNEL RECORDS, AND 74 PERCENT RESPONDED TO A PRETESTED MAIL QUESTIONNAIRE. SOME FINDINGS WERE--(1) AGE, NOT SKILL OBSOLESCENCE, SEEMED TO HAVE BEEN THE CRITERION FOR LAYOFF, (2) EMPLOYERS' HIRING POLICIES DISCRIMINATED AGAINST THE OLDER APPLICANT, (3) THE INFLUENCE OF AGE ON THE PERIOD OF UNEMPLOYMENT INCREASED AS THE EDUCATIONAL LEVEL WENT DOWN, (4) THE MEDIAN PERIOD OF UNEMPLOYMENT WAS 12 WEEKS, (5) JOB SEARCH METHODS INCLUDED THE USE OF DIRECT APPLICATIONS, FRIENDS AND PERSONAL CONTACTS, THE STATE DEPARTMENT OF EMPLOYMENT, AND PROFESSIONAL SOCIETIES, (6) UNEMPLOYMENT INSURANCE WAS THE PRIMARY SOURCE OF INCOME DURING LAYOFF BUT WAS INADEQUATE, (7) SHIFTS FROM DEFENSE TO COMMERCIAL WORK WERE COMMON, (8) 21 PERCENT OF THE LAID OFF PERSONNEL LEFT THE STATE, AND (9) THE 1,184 SCIENTISTS AND ENGINEERS LAID OFF BY DEFENSE-ORIENTED INDUSTRIES IN THE BAY AREA COMPARED TO 6,600 IN THE STATE AND 30,000 IN THE COUNTRY AS A WHOLE REPRESENTED A DISPROPORTIONATE RATE OF UNEMPLOYMENT FOR THE AREA. CHARTS AND TABLES PRESENT DATA FOR EACH ASPECT OF THE STUDY, AND THE APPENDIXES INCLUDE SAMPLES OF THE QUESTIONNAIRES USED. (HC)

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A STUDY OF THE RE-EMPLOYMENT AND UNEMPLOYMENT EXPERIENCES OF SCIENTISTS AND ENGINEERS LAID OFF FROM 62 AEROSPACE AND ELECTRONICS FIRMS IN THE SAN FRANCISCO BAY AREA DURING 1963-65

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FEBRUARY, 1967

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U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION

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FINAL REPORT

A STUDY OF THE RE-EMPLOYMENT AND UNEMPLOYMENT EXPERIENCES OF SCIENTISTS AND ENGINEERS LAID OFF FROM 62 AEROSPACE AND ELECTRONICS FIRMS IN THE SAN FRANCISCO BAY AREA DURING 1963-65

to

THE OFFICE OF MANPOWER POLICY, EVALUATION, AND RESEARCH
U. S. DEPARTMENT OF LABOR

by

R. P. LOOMBA

February 15, 1967

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PREFACE

The material in this report was prepared under a contract with the Office of Manpower Policy, Evaluation, and Research, U. S. Department of Labor, under the authority of Title I of the Manpower Development and Training Act of 1962, as amended. Researchers undertaking such projects under government sponsorship are encouraged to express freely their professional judgment. Therefore, points of view or opinions stated in this document do not necessarily represent the official position or policy of the Department of Labor.

This study, which was started in April 1965, has been conducted under U. S. Department of Labor Contract No. 81-04-27 and guided by Mr. Robert E. Manifold, Chief, Manpower Research Contracts Group, and Mr. Richard L. Fogarty of the Manpower Research Contracts Group, who gave continuous direction to all phases of this study.

This author is indebted to many individuals, in the Department of Labor, in the California State Department of Employment, and in the companies studied, for their active support and interest. He is particularly grateful to Dr. George S. Roche, Chief of Research and Statistics, California State Department of Employment for his assistance in obtaining the preliminary data for this study.

The author wishes to thank his colleagues at San Jose State College for their support, aid, comments, and criticism. He wishes to especially thank Dr. Alvin Rudoff for his assistance in the preparation of the final report, Miss Susan Admire for her help in field work and secretarial support, and Mr. R. C. Malhotra for his data processing and computer programming support.

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R. P. Loomba, Director
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San Jose, California
February, 1967

A STUDY OF THE RE-EMPLOYMENT AND UNEMPLOYMENT EXPERIENCES OF SCIENTISTS AND ENGINEERS LAID OFF FROM 62 AEROSPACE AND ELECTRONICS FIRMS IN THE SAN FRANCISCO BAY AREA DURING 1963-65

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CHAPTER I

INTRODUCTION

1.1 Objectives of the Study

The primary objective of this study is to analyze selected aspects of unemployment and re-employment experiences of a population of 1,184 engineers and scientists who were permanently laid off by sixty-two defense-oriented aerospace and electronics companies in the San Francisco Bay Area during the 18-month period ending March 31, 1965. Furthermore, the study describes the magnitude of the San Francisco Bay Area's scientific and engineering unemployment problem in relation to total employment in the area's aerospace and electronics industry and in the context of similar data for the country as a whole. The main objectives are as follows:

(a) Description of the magnitude of the problem, considering:

(1) Total blue and white collar employment in the aerospace and electronics industries within the San Francisco Bay Area as compared to a corresponding national figure;

(2) Total employment of scientists and engineers in the aerospace and electronics industries within the San Francisco Bay Area as compared to a similar national figure;

(3) Number of engineers and scientists laid off by the San Francisco Bay Area's aerospace and electronics companies during 1964 and the number of such persons who still remain unemployed; and

(4) Analysis of the rate and of some aspects of the impact of unemployment of scientists and engineers during the survey period (October 1963 - March 1965) in relation to changes in the local and the national economic climate.

(b) Identification of the laid off personnel in regard to:

(1) Personal characteristics

(2) Nature and duration of educational background

(3) Employment history from January 1, 1961 through December 31, 1965

(c) Investigation of the adequacy of other income sources during the layoff period

(d) Analysis of job search activities

(e) Examination of the problems faced by defense engineers and scientists in transferring to commercial jobs

(f) Investigation of the impact of age, education, pre-layoff salary, etc., on re-employment

1.2 Definitions:

For the purpose of this study the following definitions are used.

1.2.1 Laid off:

The term laid off is defined as permanently separated from the original employer due either to the cancellation or termination of a defense contract, or to a change in defense procurement requirements. This definition excludes any required minimum period of unemployment and allows for inclusion within the study of those scientists and engineers who were laid off, found immediate employment, and suffered no period of unemployment.

1.2.2 Defense-oriented Firm:

A firm is defined as defense-oriented if 75 percent or more of its net sales are derived from one or more of the following three sources:

(a) Department of Defense

(b) Atomic Energy Commission

(c) National Aeronautics & Space Administration

1.2.3 San Francisco Bay Area:

The area covered by the counties of Alameda, Contra Costa, Marin, San Francisco, San Mateo, Santa Clara, and Solano is defined as the San Francisco Bay Area.

1.2.4 Engineer:

An engineer is defined as a person actually engaged in chemical, civil, electrical, mechanical, metallurgical, or any other type of engineering work at a level which requires knowledge of engineering acquired through completion of a 4-year college course with a major in one or more of these fields, regardless of whether he/she holds a college degree in the field. Only persons engaged in research-development, production, management, technical service, technical sales, or other positions which require the use of the indicated level of knowledge are included. Those persons who possess engineering training but are employed in positions not requiring the use of such training are excluded. Architectural engineers are included, but architects are excluded.[1]

1.2.5 Scientist:

A scientist is defined as a person actually engaged in scientific work at a level which requires knowledge of physical, life, engineering, or mathematic sciences equivalent at least to that acquired through completion of a 4-year college course with a major in one of these fields, regardless of whether he/she holds a college degree in the field. Only persons engaged in research-development, production, management, technical service, technical sales, and other positions which require them to use the indicated level of knowledge are included. Those persons who are trained in science but are employed in positions not requiring the use of such training are excluded. Psychologists and social scientists are not included.[2]

1.2.6 Commercial Job:

A commercial job is defined as an employment that engages engineers or scientists in the design, development, production, or sale of goods and services for the commercial sector of the economy. Such an employment excludes any work, directly or indirectly, financed by (a) the Department of Defense, (b) the Atomic Energy Commission, and (c) the National Aeronautics and Space Administration.

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[1] Bureau of Labor Statistics, U.S. Department of Labor, Employment of Scientific and Technical Personnel in Industry-1962, Bulleton No. 1418 (June 1964), p. 84.

[2] *Ibid*., p. 84.

1.3 The Companies Involved

The population for this study consists of all defense companies which are located in the seven counties of the San Francisco Bay Area and had engineering and scientific layoffs during the period October 1, 1963 to March 31, 1965. The names of the seven counties involved are: Alameda, Contra Costa, Marin, San Francisco, San Mateo, Santa Clara, and Solano. The area and population for these counties are 5,036 square miles and 4.102 million[3] inhabitants, respectively. Considering total population in the State, approximately 20 percent of all Californians reside in these seven counties.

After an exhaustive search,[4] it was found that a total of 62 defense companies were involved in engineering and scientific layoffs during the above mentioned period. The county distribution for these companies is shown in Table 1. It can be observed from Table 1 that there were no engineering and scientific layoffs by defense-oriented firms in Marin and Solano counties. The reader should note that there were engineering and scientific layoffs in both of these counties from non-defense firms during the period under consideration. It was found that in the seven counties of the San Francisco Bay Area, out of a total of more than 1200 non-defense companies, 314 had engineering and scientific layoffs during the 18-month period ending March 31, 1965. Nine percent of these companies are located in Marin and Solano counties. Table 2 gives the county distribution for the non-defense companies involved. The analysis of non-defense layoffs, however, is beyond the scope of this study.

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[3] Based on the latest available data as of June 10, 1966. Information obtained from the Office of the Planning Commission for each county.

[4] For details see "The Sources of Population Data," Section 1.5.

TABLE 1

DISTRIBUTION BY COUNTIES OF THE DEFENSE COMPANIES WHICH HAD ENGINEERING AND SCIENTIFIC LAYOFFS DURING THE PERIOD OCTOBER 1, 1963 - MARCH 31, 1965

Name of the County	Number of Companies Which Had Engineering and Scientific Layoffs	Percent in Each County
Santa Clara	35	56.4%
San Mateo	16	25.8
Contra Costa	5	8.1
Alameda	5	8.1
San Francisco	1	1.6
Marin	0	0.0
Solano	0	0.0
TOTAL	62	100.0

TABLE 2

DISTRIBUTION BY COUNTIES OF THE NON-DEFENSE COMPANIES WHICH HAD ENGINEERING AND SCIENTIFIC LAYOFFS DURING THE PERIOD OCTOBER 1, 1963 - MARCH 31, 1965

Name of the County	Number of Companies Which Had Engineering and Scientific Layoffs	Percent in Each County
Santa Clara	104	33.2%
San Francisco	82	26.1
San Mateo	46	14.6
Alameda	46	14.6
Marin	14	4.5
Solano	14	4.5
Contra Costa	8	2.5
TOTAL	314	100.0

1.4 The Individuals Involved

This study deals with the population of 1,184 engineers and scientists who were laid off by 62 defense-oriented companies located in the San Francisco Bay Area during the 18-month period ending March 31, 1965. It should be noted that accompanying these professional engineering and scientific layoffs, there were a large number (approximately 8,000) of layoffs of administrative, clerical, and technician personnel.[5] The county distribution for these 1,184 layoffs is shown in Table 3. It can be observed that Santa Clara County accounted for 89.4 percent of the total engineering and scientific layoffs in the San Francisco Bay Area.

TABLE 3

DISTRIBUTION BY COUNTIES OF THE DEFENSE-ORIENTED ENGINEERING AND SCIENTIFIC LAYOFFS DURING THE PERIOD OCTOBER 1, 1963 - MARCH 31, 1965

Name of the County	Number of Engineering and Scientific Layoffs	Percent in each County
Santa Clara	1,060	89.4%
San Mateo	82	7.0
Contra Costa	34	2.9
Alameda	7	0.6
San Francisco	1	0.1
Marin	0	0.0
Solano	0	0.0
TOTAL	1,184	100.0

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[5] R. P. Loomba, "Some Thoughts on Engineering Layoffs," IEEE Transactions on Education, Vol. E-8 (June - September, 1965), pp. 71-77.

In addition to the 1,184 defense layoffs, there were an additional 559 engineering and scientific layoffs by 314 non-defense companies during the 18-month period under consideration. It was found that whereas Solano and Marin counties had no layoffs of defense personnel, both of these counties contributed 7.0 percent of the layoffs of non-defense engineers and scientists. Santa Clara County, which accounted for 89.4 percent of the defense layoffs, had 40.1 percent of the non-defense layoffs. Furthermore, it was observed that while the defense layoffs were heavily concentrated in Santa Clara County, in terms of individuals involved, the non-defense layoffs were more evenly distributed among the seven counties under consideration.

1.5 The Sources of Population Data

The preliminary data for this study consist of the following information concerning engineers and scientists laid off by the 62 defense-oriented companies under consideration.

(a) Name, home address, and telephone number

(b) Age

(c) Educational background

(d) Area of specialization

(e) Pre-layoff salary

(f) Name and type (defense or non-defense) of the company from which laid off

The detailed preliminary data were obtained for the purpose of drawing a sample, in the event the total population proved to be too large. Since only 1,184 engineers and scientists were laid off, the total population was studied and no sample was drawn. The preliminary data were derived from the following four sources:

1. Files of 25 defense companies
2. Files of the California State Department of Employment
3. Files of the Technical Placement Co-op.[6]
4. Friends of laid off engineers and scientists

---

[6] This organization was formed by laid off engineers and scientists during May 1964, and is not in existence any longer. The Manpower Research Group of the Center for Interdisciplinary Studies at San Jose State College has all the files for this organization.

1.5.1 The Company Files

A total of 105 defense-oriented aerospace and electronics companies located in the San Francisco Bay Area were contacted. The executives of 31 of these companies indicated they had engineering and scientific layoffs during the period under consideration. Twenty-five of these 31 companies rendered complete cooperation and provided preliminary data in regard to engineers and scientists laid off by them. The remaining six companies refused to cooperate. Preliminary data for these six companies (and an additional 31 companies) was obtained from the local and central files of the California State Department of Employment.[7]

It should be mentioned that a few of the 25 cooperating companies apparently provided only partial preliminary data. During the process of searching through the local files of the California State Department of Employment, several additional individuals who had been laid off by these few companies were located.

The files of the 25 cooperating companies are the major source of the preliminary data.

1.5.2 California State Department of Employment Files

The second major source of preliminary data for this study is the 62 offices of the California State Department of Employment (CSDE). During the early stages of the study, the active as well as the inactive files of the 10 local offices of the CSDE were searched. These 10 offices are located throughout the seven counties of the San Francisco Bay Area. During the search, preliminary data concerning additional laid off engineers and scientists were obtained. In addition, this search provided names of 31 additional defense companies which had engineering and scientific layoffs during the 18-month period ending March 31, 1965. In the case of companies which had provided partial layoff data, uncooperating companies, and additional companies which were later found to have had engineering and scientific layoffs, population data were obtained by more extensive search of the CSDE files.

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[7] The access to CSDE files under Section 322 of the California Unemployment Insurance Code was limited to authorized members of the project staff in a manner to ensure full compliance with Section 1094 relating to disclosure of confidential information.

1.5.3 Technical Placement Co-op Files

This organization was formed by a number of laid off engineers and scientists during the month of May 1964 in order to help themselves obtain re-employment. The activities of this organization included (a) sessions on writing impressive resumes, (b) mutual exchanges of job availability information, (c) invitations to perspective employers, (d) discussions on how to start small business concerns, etc. During the month of June 1965, the last officers of this organization handed over all their records and files to the then Engineering Manpower Research Project at San Jose State College. The files of this organization provided additional preliminary data concerning laid off engineers and scientists.

1.5.4 Friends of Laid Off Engineers and Scientists

In the case of companies which had given partial layoff data, uncooperating companies, and additional companies which were later found to have had engineering and scientific layoffs, the individuals whose names were obtained from the above-mentioned three sources were requested to supply on a voluntary basis preliminary data concerning other engineers and scientists who were laid off from the same company.

1.6 The Collection of Major Data

The major data concerning laid off engineers and scientists were obtained with the help of a pretested mail questionnaire.[8] The first copy of the questionnaire was mailed on the 19th of November 1965. Three reminders were mailed to the non-respondents at two-week intervals. The still remaining non-respondents were contacted by phone during the last two weeks of January 1966.

The statistical data concerning the firms involved were compiled with the help of mail questionnaires[9] followed by a single reminder on the phone.

1.7 The Response Rate

Out of the population of 1,184 defense engineers and scientists contacted by mail, after three mail reminders, a total of 733 usable, completed questionnaires were received. Moreover, 275 subjects did not leave their forwarding addresses and the questionnaires mailed to these individuals were returned by the U.S. Post Office. A check of the local and county telephone listings showed that it was not possible to contact these 275 individuals even by telephone. It appears that either these 275 subjects had moved away from the area or some of them had unlisted numbers. The total number of engineers and scientists contacted by both mail and phone is 909.

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[8] For details of the questionnaire and the accompanying letter, see Appendix A.

[9] For details of the questionnaires, see Appendix B.

Of the 176 remaining non-respondents, 157 were laid off during 1964; 13 during the first quarter of 1965; and 6 during the last quarter of 1963. From the 157 non-respondents who were laid off during 1964, a sample of 52, drawn on a ration of 1 in 3, was contacted by phone. Forty-four of these 52 contacted completed the questionnaire over the telephone. Of the remaining 19 non-respondents who were laid off either during the first quarter of 1965 or during the last quarter of 1963, no sample was drawn. All of these 19 non-respondents were contacted, and 11 of them completed the questionnaire. A summary of returns is shown in Table 4.

TABLE 4

SUMMARY OF RETURNS

Period during which laid off	Questionnaires Completed by mail	Questionnaires Completed by phone	Weighted Responses by phone	Total Response (Weighted)
1964	656	44*	132*	788
First Quarter of 1965	69	7	7	76
Last Quarter of 1963	8	4	4	12
TOTAL	733	55	143	876

* Based on a sample of 52 non-respondents, drawn on a ration of 1 in 3.

A total of 876 (weighted) completed, usable questionnaires were received. If the 275 individuals who were not contacted (did not receive the questionnaire) are considered as non-respondents, a net response rate of 74 percent was obtained.

In the case of 275 subjects who could not be contacted, either by mail or by telephone, data concerning age, educational background, and pre-layoff salary were obtained from company files and/or files of the California State Department of Employment. A comparative analysis of age, educational background, and salary for the 876 respondents and the 275 subjects who could not be contacted was conducted. On the basis of chi square tests, it was found that there is no difference between the two groups at a 5 percent level of significance. If it is assumed that these 275 individuals would have replied in the same proportion as the other 909 who did receive the questionnaire, the response rate for this study becomes 96 percent.

1.8 Summary

The primary objective of this research project is to examine the unemployment and re-employment experiences of the population of 1,184 engineers and scientists who were laid off by 62 defense-oriented firms in the San Francisco Bay Area during the 18-month period ending March 31, 1966. This study, in addition to describing the magnitude of the layoff problem, analyzes (a) the job search activities of laid off engineers and scientists, (b) adequacy of income sources during the period of unemployment, (c) problems of transferring from defense to commercial jobs, and (d) impact of age, education, pre-layoff salary, etc., on re-employment.

The preliminary data consisting of names, addresses, telephone numbers, age, salary, area of specialization, and educational background of the subjects were derived from company files, files of the California State Department of Employment, Technical Placement Co-op files, and friends of laid off engineers and scientists. The major data for this study were obtained by means of a pretested mail questionnaire. A net response rate of 74 percent was obtained.

CHAPTER II

MAGNITUDE OF THE LAYOFF PROBLEM

2.1 Engineering and Scientific Layoffs

Layoffs by defense-oriented aerospace and electronics companies affected approximately 120,000 individuals during the period January 1963 to December 1964.[10] This figure of 120,000 does not include layoffs by non-defense companies and layoffs due to closing of defense establishments, such as the Brooklyn Naval Yard. In the State of California, defense-oriented aerospace and electronics firms laid off a total of 26,400 workers. For the San Francisco Bay Area the corresponding figures is 6,000 persons. The non-defense companies in the San Francisco Bay Area, however, laid off an additional 4,000 workers during the same period.

It is difficult to determine the exact national and statewide figures concerning the number of engineers and scientists involved in these layoffs. A rough estimate can be obtained by using a rule of thumb developed in a recent study.[11] According to this study, professional engineers and scientists normally account for one-fourth of the total employment in defense-oriented aerospace and electronics firms. Thus, the number of engineers and scientists involved in the 1963-64 layoffs throughout the United States can be estimated at 30,000. In California, approximately 6,600 engineers and scientists became victims of involuntary layoffs. In the San Francisco Bay Area, during the 18-month period ending March 31, 1965, according to the data gathered by the Manpower Research Group, defense-oriented firms laid off a total of 1,184 engineers and scientists. The non-defense companies in the San Francisco Bay Area laid off an additional 559 engineers and scientists during the same period.

Table 5 shows comparative indices for the San Francisco Bay Area, California, and the U.S.A. of engineers and scientists on unemployment insurance rolls during the period May 1963 to February 1965. The absolute numbers on which these indices are based do not represent the total population of engineers and scientists affected by defense cutbacks for the following three reasons:

1. Certain laid off engineers and scientists cannot claim unemployment insurance because of the nature of the organization or company they worked for prior to layoff.

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[10] For details see Appendix C.

[11] Albert Shapero, An Exploratory Study of the Structures and Dynamics of the Defense Industry, Stanford Research Institute (June 1964).

2. A large number of engineers and scientists prefer to resign from their jobs rather than have their personal records marked "laid off". This causes them to forfeit their claim to unemployment insurance.

3. Individuals who remain unemployed for relatively longer periods of time are eliminated from unemployment insurance rolls at the end of their eligibility.

TABLE 5

COMPARATIVE INDICES OF ENGINEERING AND SCIENTIFIC UNEMPLOYMENT (ENGINEERS AND SCIENTISTS ON UNEMPLOYMENT INSURANCE ROLLS)

Area Date	San Francisco* Bay Area May 1963 = 341	California**,*** May 1963 = 1,318	U.S.A.**** May 1963 = 7,099*****
May '63	100	100	100
August '63	99	93	95
November '63	77	75	84
February '64	96	104	128
May '64	146	141	118
August '64	150	174	114
November '64	131	163	92
February '65	87	127	96

*Based on data obtained from the California State Department of Employment, San Francisco Area Office.

**Department of Employment, State of California, Report 81U #243-9, Research and Statistics Division, Sacramento (28 May 1965) mimeo.

***Department of Employment, State of California, Report 81U #243-16, Research and Statistics Division, Sacramento (8 March 1965) mimeo.

****The fifty states, District of Columbia, and Puerto Rico.

*****Based on data obtained personally from the Bureau of Employment Security, U.S. Department of Labor, Washington, D. C.

Table 6 is based on the same data as Table 5, but gives comparative figures for engineers and scientists on unemployment insurance rolls computed as percentages of the corresponding national figures.

According to a recent survey conducted by the Engineers Joint Council, 13.2 percent of the nation's engineers work in California.[12] If a similar percentage is assumed for scientists working in California, unemployment among engineers and scientists in California was relatively heavier than in the nation as a whole (Table 6). During the period May 1963 to February 1965, unemployed engineers and scientists in California constituted from a minimum of 15 percent to a maximum of 33 percent of the nation's unemployed engineers and scientists.

TABLE 6

COMPARATIVE FIGURES FOR ENGINEERS AND SCIENTISTS ON UNEMPLOYMENT INSURANCE ROLLS SHOWN AS PERCENTAGE OF CORRESPONDING NATIONAL FIGURES

Area / Date	San Francisco Bay Area	California
May 1963	4.8%	18.6%
August 1963	5.0	18.2
November 1963	4.0	16.5
February 1964	3.6	15.0
May 1964	5.9	22.1
August 1964	6.5	29.1
November 1964	6.9	33.0
February 1965	4.4	24.7

On the basis of data obtained from the 80 largest defense and non-defense companies in the San Francisco Bay Area, and after making allowances for engineers and scientists working for companies not represented in the sample, it is estimated that on April 30, 1966 there were a total of 25,000 engineers and scientists employed by industry in this area.[13] These 25,000 engineers and scientists constitute approximately 2 percent of the national figure of 1,353,000 engineers and scientists employed by industry.[14] During the period May 1963 to February 1965, engineering and scientific unemployment in the San Francisco Bay Area varied from a low of 3.6 percent to a high of 6.9 percent of the number of engineers and scientists unemployed throughout the county (Table 6). The San Francisco Bay Area, therefore, suffered relatively more serious professional technical unemployment during the 21-month period ending February 28, 1965 than the county as a whole.

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[12] Engineers Joint Council, Engineering Manpower in Profile, EJC, New York (1965).

[13] For details see Appendix B.

An examination of Table 5 reveals that the fluctuation (42 points) in the index of engineering and scientific unemployment in California is wider than the comparable fluctuations for the country (12 points) and for the San Francisco Bay Area (16 points). It appears that areas such as Sacramento, Los Angeles, and San Diego had more serious engineering and scientific unemployment than the San Francisco Bay Area. From the data it appears that the peak of engineering and scientific unemployment in California and the San Francisco Bay Area probably occurred in August 1964, six months after the peak in national engineering and scientific unemployment. This could be due to the fact that most of the layoffs on the East Coast occurred during the middle of 1963; whereas, the California layoffs started in early 1964. Yet, one must not ignore the possibility that some unemployed East Coast engineers and scientists who were laid off during the middle of 1963 might not have been included in the data because they would have exhausted their benefits by the spring and fall of 1964.

The indices contained in Table 5 for February 1965 and November 1963 (lowest unemployment) show that, as of February 1965, the index for California was still 52 points off from its best level. For the San Francisco Bay Area the index of engineering and scientific unemployment in February 1965 was only 10 points off from its best level (November 1963). Thus, either the pick-up in engineering and scientific employment was the fastest in the San Francisco Bay Area; or a relatively larger number of unemployed engineers and scientists within the San Francisco Bay Area exhausted their benefits prior to February 1965; or a great many unemployed engineers and scientists left the San Francisco Bay Area.

2.2 Engineers and Scientists Currently Unemployed in the San Francisco Bay Area.

As of February 22, 1966, there were a total of 108 engineers and scientists who were still unemployed. Sixty-three of these individuals were laid off by defense-oriented firms and the remaining 45 by non-defense firms. These 108 individuals constitute 6 percent of the total number of engineers and scientists laid off by defense and non-defense companies in the San Francisco Bay Area during the 18-month period ending March 31, 1965. A detailed analysis of the total population of unemployed defense engineers is presented in Chapter 7 of this report.

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[14] Bureau of Labor Statistics, Occupational Outlook Report Series, Bulletin Nos. 1450-8,-29,-32,-47,-62, U.S. Department of Labor (1966).

Seventy-two percent of these 108 unemployed engineers and scientists are over 40 years of age, and only 15 percent are below 30 years of age. In regard to their educational level, 3 percent possess Doctor's Degrees, 17 percent Master's Degrees, 41 percent Bachelor's Degrees, and 39 percent are non-degree individuals. This group contains a relatively larger number of non-degree individuals than the total population of laid off engineers and scientists in the San Francisco Bay Area.[15] Table 7 shows that industrial engineering and electrical engineering are the two areas of specialization which are represented rather heavily among the currently unemployed group. In the total population of laid off engineers, industrial engineers consisted of only 8.6 percent; whereas among the currently unemployed group, 25 percent are industrial engineers. The proportion of electrical engineers among the currently unemployed (23 percent) does not differ appreciably from the percentage of electrical engineers (27 percent) among the total population of laid off engineers and scientists.

TABLE 7

AREA OF SPECIALIZATION FOR UNEMPLOYED ENGINEERS AND SCIENTISTS

Industrial Engineers	= 25%
Electrical Engineers	= 23
Chemists	= 11
Civil Engineers	= 7
Mechanical Engineers	= 5
Mathematicians	= 4
Chemical Engineers	= 4
Others	= 21

2.3 The Nature of Engineering and Scientific Employment

2.3.1 The National Market

According to a survey conducted by the Bureau of Labor Statistics during 1964,[16] there was a total of 1,353,000 engineers and scientists employed by industry throughout the country. Approximately 80 percent of these technical professionals are engineers and the remaining 20 percent are scientists. A further breakdown of the data shows that of the 875,000 engineers; 59 percent are employed in manufacturing industries, 23 percent by non-manufacturing firms, 15 percent by Federal, State and local government agencies, and 3 percent by educational institutions. The rate of growth for the engineering and scientific population was 6.4 percent between 1959-60; 6.1 percent between 1960-61, and 4 percent between 1961-62.

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[15] In the total population of laid off engineers, 25 percent are non-degree individuals.

[16] Bureau of Labor Statistics, Occupation Outlook (1966).

It is difficult to obtain precise information concerning engineers and scientists employed by the nation's aerospace and electronics industries. The Aerospace Industries Association's data regarding engineers and scientists employed by the aerospace industries goes as far back as March 1965.[17] On the basis of these figures, during 1965, aerospace companies employed an average of 191,750 engineers and scientists. During the first six months of 1966 the AIA estimated average for the number of engineers and scientists employed by aerospace companies is 212,500.

The Electronics Industries Association does not conduct any survey of its own. From indirectly obtained figures, the Washington, D.C., office of the Electronics Industries Association estimates that during 1965 there were 140,000 engineers and scientists employed by the electronics industries throughout the nation. According to the Battelle Memorial Institute of Columbus, Ohio, the electronics industries in 1965 employed a total of 167,000 engineers and scientists. The Stanford Research Institute and the Fairchild News Service estimate this figure to be 155,000, and 150,000 respectively.[18] It should be noted that the figures presented for the aerospace industries and the electronics industries are not mutually exclusive. There is a considerable amount of duplication of companies in the aerospace firms and electronics companies considered in the two types of data.

2.3.2 The San Francisco Bay Area

The data concerning engineers and scientists employed by aerospace and electronics firms located in the San Francisco Bay Area were obtained with the help of mail questionnaires[19] followed by telephone reminders. A total of 104 largest aerospace and electronic firms were contacted and replies were received from 80 of these companies.

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[17] Aerospace Industries Association of America, Inc., Aerospace Employment in the United States by Region, Economic Data Branch, Washington, D.C. (August 1965).

[18] Charles S. Peck, A Study of Implications of Reduced Defense Demand for the Electronics Industry, Battelle Memorial Institute, Columbus, Ohio (July 1965).

[19] For details of the questionnaires see Appendix B.

It is estimated these 80 firms employ 90 percent of the total number of engineers and scientists employed by the aerospace and electronics industries in the San Francisco Bay Area. In order to compute the total number of engineers and scientists employed by aerospace and electronics industries, the data obtained from these 80 companies was, therefore, multiplied by a factor of 1.1. Table 8 shows the comparative indices of engineering and scientific employment in the San Francisco Bay Area during the period January 1, 1963 to April 30, 1966. Using the AIA figures for engineers and scientists working for aerospace and electronic industries, the San Francisco Bay Area seems to have employed at least 6 percent of the nation's aerospace and electronics engineers during 1965.

TABLE 8

COMPARATIVE INDICES OF ENGINEERING AND SCIENTIFIC EMPLOYMENT IN THE SAN FRANCISCO BAY AREA JANUARY 1963 - APRIL 1966

Industry / Date	Aerospace and Electronics January '63 = 19,710	Defense Oriented Aero. & Elect. January '63 = 16,050	Non-Defense Aero. & Elect. January '63 = 3,660
January '63	100	100	100
January '64	108	107	113
January '65	101	98	117
May '65	103	99	120
January '66	107	102	129
April '66	112	106	134

An examination of Table 8 shows that, contrary to what happened in the defense sector of the economy, engineering and scientific employment in the non-defense companies of the San Francisco Bay Area increased continuously between January 1963 and April 1966. The average rate of growth for the non-defense companies has been approximately 10 percent per year. However, between 1964-65, the period of defense layoffs, the growth rate was only 4 percent.

In the case of defense-oriented aerospace and electronics companies the average rate of growth during the period January 1963 to April 1966 was 2 percent per year. This rate of growth is approximately one-fifth of the corresponding rate for commercial companies in the San Francisco Bay Area. On account of layoffs, the index of defense engineering and scientific employment dropped 9 points between January 1964 and January 1965. Furthermore, as of April 30, 1966, engineering and scientific employment in the defense companies was below the corresponding figures for January 1964.

2.4 Total Employment in Aerospace and Electronics Industries

The Industry Manpower Survey No. 111 conducted by the Bureau of Employment Security of the U.S. Department of Labor shows that aerospace employment totaled 1,136,500 in August 1963, representing a decrease of 0.3 percent from August 1962.[20] A similar survey, conducted one year later revealed that aerospace employment in August 1964 declined by 6.9 percent to 1,103,000.[21]

According to these two surveys, the missile and space vehicle employment in California increased by 3.3 percent, to 295,300, during 1962-63. However, during 1963-64, the same figure declined by 6 percent. In the San Jose area, missile and space vehicle employment increased by 9.7 percent to 39,500 between August 1962 and August 1963; but decreased by 10.4 percent during 1963-64.

Table 9 shows comparative indices of total employment in aerospace and electronics industries in the San Francisco Bay Area for the period January 1963 to April 1966. As can be observed from this table, the total aerospace and electronics employment in the San Francisco Bay Area increased at an average rate of 1.8 percent per year during the 40-month period ending April 30, 1966. The similar increase for the non-defense sector of the industry was 14.4 percent. The defense-oriented employment, however, decreased at an average rate of 0.1 percent. The non-defense aerospace and electronics employment in the San Francisco Bay Area increased continuously during 1963-1966; but the index of defense employment in January 1965 was 12.6 points below its maximum of January 1964.

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[20] Bureau of Employment Security, Aerospace Employment, Industry Manpower Survey No. 111, U.S. Department of Labor, Washington, D. C. (June 1964).

[21] Bureau of Employment Security, Aerospace Employment, Industry Manpower Survey No. 112, U.S. Department of Labor, Washington, D. C. (May 1965).

TABLE 9

COMPARATIVE INDICES OF TOTAL EMPLOYMENT IN AEROSPACE AND ELECTRONICS INDUSTRIES IN THE SAN FRANCISCO BAY AREA 1963-1966

Date	Total 1963 = 78,400	Defense Oriented 1963 = 63,100	Non-defense 1963 = 15,300
January 1963	100	100	100
January 1964	103.6	102.2	108.9
January 1965	93.6	89.6	111.8
May 1965	95.7	91.4	112.8
January 1966	101.9	96.2	135.6
April 1966	106.5	99.7	150.5

2.5 Impact of Defense Layoffs

Both the State of California and the San Francisco Bay Area suffered more severe engineering and scientific unemployment during 1963-65 than the country as a whole. For instance, engineers and scientists on unemployment rolls in the State of California constituted from a minimum of 15 percent to a maximum of 33 percent of the corresponding national figures. These percentages are relatively higher when considered in light of the fact that approximately 13 percent of the nation's engineers and scientists reside in California.

In the San Francisco Bay Area, the home of approximately 2 percent of the U.S. scientists and engineers, unemployed engineers and scientists constituted 3.6 to 6.9 percent of the respective national totals. The layoff of 2,000 engineers and scientists, and 8,000 additional supporting personnel, meant a sizeable payroll loss to the region. A rough estimate of this annual payroll loss can be obtained if one considers the fact that 38 percent of the laid off employees left the San Francisco Bay Area and that the remaining 62 percent were unemployed for an average of 3 months subsequent to their layoff. If it is assumed that the engineers and scientists earned on the average $10,000 per year and that non-engineers and scientists had an average salary of $5,000 per year, then the 1964 layoffs meant an approximate payroll loss of 30 million dollars to the area. About 60 percent of this payroll reduction was concentrated in the Santa Clara County. Undoubtedly the multiplier affects of this reduction in take-home pay influenced other local businesses such as the real estate market, department store sales, restaurant business, etc.

It appears that the defense layoffs resulted in a chain reaction which caused engineering and scientific layoffs by non-defense companies. For instance, in the San Francisco Bay Area, the non-defense companies laid off 4,000 workers during the 18-month period ending March 31, 1966. The total number of engineers and scientists laid off during the same 18-month period by these commercial companies is 559. These layoffs were caused primarily by curtailment in construction activities by some rapidly expanding defense-oriented and non-defense firms and by cut-backs in the expansion programs of some utility companies. These cut-backs were instituted as a result of mass layoffs in the area.

Table 10 shows percentages of the total defense and non-defense layoffs for five different time periods. This data is based on the layoff dates of engineers and scientists. An examination of Table 10 reveals that while most of the defense layoffs occurred during January 1964 to August 1964; 67.8 percent of the non-defense layoffs occurred during the period September 1964 to March 1965.

After the layoffs, the pick-up in engineering and scientific employment was the fastest in the San Francisco Bay Area, when compared with similar figures for the State of California and the nation as a whole. For example, the index of engineering and scientific unemployment for the San Francisco Bay Area (Table 5) in February 1965 was only 10 points above its lowest level since May of 1963. The similar national and State figures in February 1965 were, respectively, 12 and 52 points above their lowest levels since May of 1963. As a result of this fast pick-up in professional hiring, the total engineering and scientific employment (as of April 30, 1966) in the San Francisco Bay Area reached its highest level in history. This high level of employment has been achieved in spite of the fact that the latest (April 30, 1966) defense-oriented total employment is still 2.5 percent below its best level of January 1964.

TABLE 10

DATES OF DEFENSE AND NON-DEFENSE LAYOFFS IN THE SAN FRANCISCO BAY AREA (ENGINEERS AND SCIENTISTS ONLY)

Dates	Defense Layoffs N = 1184	Non-defense Layoffs N = 559
Oct.-Dec., 1963	1.8%	2.8%
Jan.-Apr., 1964	34.4	13.2
May.-Aug., 1964	33.3	16.2
Sept.-Dec., 1964	22.2	23.7
Jan.-March, 1965	8.3	44.1
Total	100.0%	100.0%

2.6 Summary

During 1963-64, defense-oriented aerospace and electronics companies throughout the nation laid off approximately 30,000 engineers and scientists. The similar figure for the State of California is 6,600 engineers and scientists. In the San Francisco Bay Area, during the 18-month period ending March 31, 1965, a total of 1,184 engineers and scientists were laid off by defense-oriented firms.

The number of engineers and scientists on unemployment insurance rolls in the State of California, during the period May 1963 to February 1965, varied from a low of 15 percent to a high of 33 percent of the total number of engineers and scientists on unemployment insurance rolls throughout the country. In the San Francisco Bay Area, the similar figure fluctuated between 3.6 and 6.9 percent. In view of the fact that only 2 percent of the country's engineers and scientists are employed in the San Francisco Bay Area, and that only 13 percent are working within the State of California; both of these regions suffered more severe engineering and scientific unemployment than the nation as a whole. Furthermore, as of February 22, 1966, six percent of the laid off engineers and scientists in the San Francisco Bay Area were still unemployed.

The data show that the local defense layoffs seem to have caused a chain reaction giving rise to engineering and scientific layoffs by non-defense companies in the San Francisco Bay Area. During the 18-month period under consideration, non-defense firms laid off approximately 4,000 workers, 559 of whom were engineers and scientists.

Aerospace and electronics firms in the San Francisco Bay Area employ approximately 25,000 engineers and scientists. Contrary to what happened in the defense sector of the local economy, engineering and scientific employment in the non-defense firms of the area increased continuously between January 1963 and April 1966. The average rate of growth for the non-defense companies has been approximately 10 percent per year. Between 1964-65, however, due to non-defense layoffs, the growth rate was only 4 percent.

CHAPTER III

PERSONAL CHARACTERISTICS OF THE RESPONDENTS

A typical respondent for this study is a married male with an average of approximately 2 dependents, excluding the spouse. To be specific, 97 percent of the respondents are males, and 3 percent are females. Eighty-four percent of the laid off engineers and scientists are married, and the remaining 16 percent are either single, divorced, or widower/widow. Of the 757 married respondents, 76 percent have one child or more, and 15 percent have dependents other than children. Furthermore, 14 percent of the unmarried respondents reported dependents other than children.

In order to examine the possible differences between the population of laid off defense engineers and scientists in the San Francisco Bay Area and the population of working defense engineers and scientists, the data were first compared with similar information regarding 30,000 working engineers and scientists from 10 different defense companies located in the Los Angeles and Boston areas.[22] This comparison with the Shapero study done at Stanford Research Institute was made for two main reasons. Firstly, the Shapero data are by far the most recently collected (1964); secondly, his data are comprised of defense oriented companies only.

Comparison with the occupational data from the Bureau of Census[23] was deemed inappropriate because of its outdatedness (1959) and its inclusion in the sample of non-defense engineers and scientists. Similarly, comparison was not made with the data from the Engineers Joint Council[24] because: (a) the information was obtained only from those engineers who at that time belonged to professional societies. Most of the non-degree individuals do not belong to any professional society. The data, therefore, are biased in favor of the degree-engineers; and (b) the data include both defense and non-defense engineers.

3.1 Educational Background

An analysis of the data shows that the educational background of the 876 laid off engineers and scientists from the San Francisco Bay

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[22] Shapero, op. cit.

[23] U.S. Department of Commerce, U.S. Census of Population 1960 - Occupational Characteristics, PC (2) 7A, U.S.G.P.O., Washington, D.C. (1963).

[24] Engineers Joint Council, op. cit.

Area does not differ significantly from the educational background of 30,163 working defense engineers and scientists from the Boston and Los Angeles areas. This conclusion was reached after obtaining a chi square value of 5.46 for Table 11. This table gives the comparative educational background for the two groups.

TABLE 11

COMPARATIVE EDUCATIONAL BACKGROUND OF WORKING ENGINEERS AND SCIENTISTS FROM THE LOS ANGELES AND THE BOSTON AREAS AND OF LAID OFF ENGINEERS AND SCIENTISTS FROM THE SAN FRANCISCO BAY AREA

Level of Education	Los Angeles and Boston Areas N = 30,163	San Francisco Bay Area N = 876
Doctor's Degree	3.3%	2.2%
M.S.	12.7	11.4
B.S.	57.5	58.4
Non-Degree	26.5	28.0
TOTAL	100.0	100.0

If one makes the assumption that the educational characteristics, of working defense engineers and scientists in the Los Angeles and Boston complexes do not differ substantially from those of the working defense engineers and scientists in the San Francisco Bay Area, it can be stated that as far as educational background is concerned there is no significant difference between the populations of laid off and working engineers and scientists in the San Francisco Bay Area. Such an assumption, in the opinion of the author, is not unreasonable in view of the similarities in the nature of defense work that various firms are conducting in the San Francisco Bay Area as compared to the Boston and Los Angeles areas.

A second comparison of the educational characteristics of engineers and scientists laid off by defense-oriented firms in the San Francisco Bay Area was made with similar information collected in a study focused upon the Boston areas.[25] This analysis shows that companies in the Boston area laid off relatively more individuals with Master's degrees and relatively fewer non-degree persons. Yet the proportions of laid off engineers and scientists with Doctor's and Bachelor's degrees do not differ appreciably in the two areas. The reader should note, however, that the educational data for the Boston study are based on information from only 290 laid off engineers and scientists representing eight firms.

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[25] Joseph D. Mooney, Displaced Engineers and Scientists: An Analysis of the Labor Market Adjustment of Professional Personnel, Ph.D. Thesis, Massachusetts Institute of Technology (June 1965).

The degree composition of the laid off engineers and scientists, in general, depends strongly on the layoff policies of the companies involved. Analysis for individual companies in the San Francisco Bay Area shows that certain firms had across-the-board layoffs, while others laid off mostly non-degree and B.S. level individuals. The overall effect for the total population of laid off engineers and scientists from 62 companies in the San Francisco Bay Area was such as to obtain educational characteristics almost identical to those of the working engineers and scientists in the Los Angeles and Boston areas combined.

3.2 Educational and Professional Activities after Graduation.

According to the summary report of a national survey of engineering graduates, 42 percent of the 3,246 respondents agreed with the statement: "My colleagues seem out-of-date, need more study".[26] Similarly, a survey of 1000 engineers and engineering-managers conducted by Princeton Creative Research Inc. reports that 95 percent of the engineers and 86 percent of the engineering managers feel that technical obsolescence is a "real problem".[27] Both of these surveys reveal a high degree of self-consciousness among engineering professionals concerning the need to keep their skills current. Executives of defense-oriented firms, too, display an alertness to the benefits of up-to-date scientific and engineering capabilities. This conclusion was reached on the basis of personal interviews by the author with executives of 52 defense-oriented firms in the San Francisco Bay Area. As a result, questions were included in this present study to determine the efforts made by laid off engineers and scientists to keep themselves updated.

3.2.1 Continuing Educational Activities

The data collected in this study on scientists and engineers laid off from defense industries show that these individuals are not only aware, but are active in regard to keeping their technical knowledge up-to-date. Table 12 shows the percentages of those respondents who completed engineering and scientific adult education, correspondence, and/or workshop courses and of those who completed courses at their place of employment. Detailed examination of the data uncovered an overlap in frequencies between those who took adult education, correspondence and/or workshop courses and those who took courses at their place of work. That is, those who completed a great many courses at work were likely to have completed a great many adult education type courses; those subjects who completed a moderate number of the former most often completed a moderate number of the latter; and those engineers and scientists who completed no courses of one type frequently completed no courses of the other type.

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[26] William K. Lebold, Robert Perruci, and Warren Howland, "The Engineer in Industry and Government," Journal of Engineering Education, Vol. 56, No. 7 (March 1966), p. 255.

[27] Princeton Creative Research Inc., "Engineers Talk About Obsolescence," Machine Design (June 18, 1964), and "Who Pays for Technical Retooling," Machine Design (July 2, 1964), and "Attitudes on Education," Machine Design (July 16, 1964).

TABLE 12

ADULT EDUCATION, CORRESPONDENCE AND/OR WORKSHOP COURSES IN SCIENCE OR ENGINEERING, AND COURSES COMPLETED AT PLACE OF EMPLOYMENT

Number of Courses	Adult Education, Correspondence and/or Workshop Courses completed in Science or Engineering N = 681	Courses Completed at place of Employ- N = 794
More than 10 courses	10.1%	9.3%
7 or more	16.2	16.6
3 or more	44.9	50.3
1 or more	62.5	76.5
No courses completed	37.5	23.3

When the data for courses beyond the last degree or diploma is studied according to areas of specialization, it is observed that a greater amount of course work is completed by individuals in the fields of aeronautical engineering, mechanical engineering, and industrial engineering. Those completing the least number of courses appear to be primarily in the fields of physics, mathematics, chemistry and chemical engineering. Perhaps the explanation for this divergence between engineers and scientists is that the latter group must return to universities for their new knowledge; whereas engineering skills are more easily acquired through adult education and courses at work. Since the questionnaire did not inquire whether individuals completed additional college courses, this hypothesis cannot be verified. Further analysis of the data show that a far greater number of civil and sanitary engineers complete courses by adult education or workshop than by programs at work. Conversely, mathematicians, electrical engineers, chemists and chemical engineers take many more courses at their place of work than adult education, correspondence and/or workshop courses.

As regards the effect of level of education on the number of courses completed, it is found that as the level of education goes down the number of workshop and/or adult education courses completed and the number of courses completed at the place of work goes up. Consequently, non-degree individuals make up an increasingly greater proportion of those completing both type of course work as the number of courses taken grows larger. For adult education, correspondence and/or workshop courses in engineering or science: of those enrolled in no courses, 22 percent are non-degree; of those enrolled in 3 or more courses, 42 percent are non-degree; and of those enrolled in more than 10 courses, 53 percent are non-degree. For courses completed at the place of work: of those participating in no course work, 23 percent are without a degree; of those participating in 3 or more courses, 33 percent are without a degree; and of those participating in more than 10 courses, 42 percent are without a degree.

When the percentages of individuals with a college degree (B.S. or beyond) completing an indicated number of courses is compared with similar percentages for non-degree personnel, the data show conclusively that those with less educational background take more course work. The explanation for this trend seems to lie in the fact that data was collected on adult education, correspondence and workshop courses and courses at the place of work only. The questionnaire failed to ask the number of additional university courses that were completed. It seemsprobable that respondents with college degrees would be most likely to return to the university for subsequent training. This inference is substantiated by considering the proportion of respondents who indicated college study beyond their B.S. degree to the total number of individuals possessing a B.S. degree. Of the 466 college-degree personnel answering the question on adult education, etc., 324 (69.5 percent) took additional course work at the university. Of the 565 college-degree personnel answering the question on courses at work, 394 (69.5 percent) took additional course work at the university.

The conclusion that non-degree engineers and scientists take relatively more courses at place of employment could be advantageously utilized by nation's defense industries in planning programs for updating employee technical skills. For approximately one-fourth of the nation's defense engineers and scientists who are non-degree, it appears that availability of pertinent technical courses at place of work is one of the effective ways of keeping their knowledge current.

3.2.2 Professional Activities

In order to further examine whether there are any salient differences between the professional activities of laid off and working engineers, the data are compared with similar information obtained by the Goals of Engineering Education Study Group.[28]

When membership in professional societies is considered, the overall trends for the two groups are quite similar. As the level of education goes up, membership in professional societies also goes up. The age of a respondent does not have any effect on the number of professional societies to which he belongs. On the basis of chi square tests, it is found that as far as membership in professional societies is concerned there is no significant difference between laid off and working engineers possessing Master's (X^2=.58, df=3) and Bachelor's (X^2=2.3, df=3) degrees. Because the population of laid off engineers contains only 16 Ph.D. engineers, no statistical tests are conducted for holders of Doctor's degrees.

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[28] LeBold, Perruci, and Howland, op. cit., p. 251.

An examination of the data concerning technical publications and patents obtained by the laid off defense engineers shows that 17 percent have publications and 15 percent were issued patents. Among the scientists, 36 percent have publications and only 7 percent received patents. Further analysis reveals that chemists and chemical engineers have both a high rate of publication and a large number of patents. Civil, mechanical and chemical engineers are the three highest groups with reference to patents. As regards publications, chemists and chemical engineers, physicists and mathematicians are among the three highest. Aeronautical engineers publish the least; and the fewest patents are obtained from mathematicians, physicists and electrical engineers.

On the basis of the chi square test (X^2=12.5, df=10) it is discovered that educational background of the respondents has no significant influence on the number of patents received. But the age of the respondents is a significant factor in determining the number of patents issued (X^2=25.5, df=14); the higher the age the more the number of patents. When technical publications are considered, age appears to have no significant influence (X^2=10.9, df=12). But the level of education seems to be a strong determining factor (X^2=79.6, df=10); respondents with higher degrees have more technical publications.

The data giving distribution of publications and patents of laid off engineers holding B.S. and M.S. degrees was compared with the findings of the national survey of graduate engineers mentioned earlier.[29] The data for respondents with Doctor's degrees were not compared because of smallness of the sample. Chi square tests have shown that as far as technical publications and patents are concerned, there is no difference between the two groups at the one percent level of significance.

3.3 Age

A comparison of age distribution of the laid off engineers and scientists with similar data for working engineers and scientists from the Los Angeles and Boston areas (Table 13) shows that, in general, defense companies in the San Francisco Bay Area laid off relatively more older workers. For instance, 32.6 percent of the laid off engineers and scientists are 45 years of age or older. In view of the estimate that approximately 17 percent of the industry's engineers and scientists are 45 years of age and above, proportionately twice as many engineers and scientists who are in the 45 years plus category were laid off in the San Francisco Bay Area. A comparison with the Boston layoff data collected by Mooney reveals that defense companies in the San Francisco Bay Area laid off relatively more older workers than the firms in the Boston Area. For example, only 2 percent of the laid off engineers and scientists from the Boston Area are in the 55 years and over category; whereas 42 percent of them are in the 35 years and below category. The corresponding figures for the San Francisco Bay Area are 10 percent and 30 percent, respectively.

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[29] Ibid., p. 251.

The data show that age of the respondents is the only criterion in which they differ significantly from the group of working engineers and scientists. As far as educational background, technical publications, patents, membership in professional societies, and number of engineering and scientific courses completed are concerned, there is no significant difference between the two groups. Further analysis of the data reveals that age of the respondents has no important influence on their educational background and their area of specialization. Chi square tests on two-way tables show that educational background and areas of specialization are both independent of age.

TABLE 13

AGE DISTRIBUTION FOR WORKING ENGINEERS AND SCIENTISTS IN THE LOS ANGELES AND BOSTON AREAS AND LAID OFF ENGINEERS AND SCIENTISTS IN THE SAN FRANCISCO BAY AREA

Age	Los Angeles and Boston Areas N = 22,318	San Francisco Bay Area N = 858
55 years and over	3.0%	10.2%
45-54 years	14.0	22.4
35-44 years	37.5	37.7
34 and below	45.5	29.7
TOTAL	100.0	100.0

3.4 Area of Specialization

The data in regard to areas of specialization for working engineers and scientists in the Los Angeles and Boston areas as compared to similar data for laid off engineers and scientists in the San Francisco Bay Area are shown in Table 14. It can be observed that, proportionately, industrial engineers suffered the heaviest from layoffs, and that electrical engineers were laid off in proportion to their total population among working engineers and scientists. In absolute numbers, electrical and mechanical engineers were affected the most.

A comparison with the Boston layoff data reveals that proportionately twice as many electrical engineers were laid off by defense-oriented firms in the Boston area as in the San Francisco Bay Area. Chemists and chemical engineers constituted only 0.4 percent of the total Boston layoffs; the similar figure for the San Francisco Bay Area is 7.1 percent. Similarly, twice as many aeronautical engineers were laid off in the San Francisco Bay Area as in the Boston Area.

TABLE 14

AREAS OF SPECIALIZATION FOR WORKING ENGINEERS AND SCIENTISTS IN THE LOS ANGELES AND BOSTON AREAS AND FOR LAID OFF ENGINEERS AND SCIENTISTS IN THE SAN FRANCISCO BAY AREA

Area of Specialization	Los Angeles and Boston Areas N = 29,066**	San Francisco Bay Area N = 944***
Chemistry*	5.5%	7.1%
Aeronautical Engineering	12.1	7.5
Electrical Engineering	26.8	27.0
Industrial Engineering	1.5	8.6
Mechanical Engineering	19.3	23.6
Others****	34.8	26.2
TOTAL	100.0	100.0

*Includes chemical engineering.
**Excludes psychologists, biologists, physiologists, medical biologists, economists, business administrators, military and naval scientists, and "other non-technical specialties."
***Includes some with degrees in more than one specialization.
****Includes small percentages from more than 15 categories.

A two-way table of educational background versus areas of specialization shows that electrical engineers, physicists, and aeronautical engineers generally possess higher degrees. Civil engineers and mechanical engineers are the lowest and the next to the lowest when formal education is considered. As was mentioned earlier, age of the respondents has no influence on their areas of specialization.

3.5 Salary

The pre-layoff salary distribution for the laid off engineers and scientists is shown in Table 15. When the data is examined, it is found that chemical engineers are the highest paid and that electrical engineers rank second in terms of pre-layoff salary. Individuals with longer experience have higher pre-layoff salaries. However, after an engineer or a scientist has worked for more than 8 years, increase in industrial experience does not seem to have an equivalent augmenting effect on their salaries. The educational background of the respondents appears to be a significant determining factor in regard to their salaries. In general, as the educational level goes up, the salaries of the laid off engineers and scientists increases correspondingly. A detailed analysis of the factors influencing salary is given in Chapter IV of this report.

TABLE 15

SALARY DISTRIBUTION FOR ENGINEERS AND SCIENTISTS
LAID OFF FROM THE SAN FRANCISCO BAY AREA

Salary	Number	Percent
$15,000 and above	56	6.4%
$12-14,999	177	20.3
$10-11,999	262	30.0
$8-9,999	275	31.5
Less than $8,000	104	11.8
TOTAL	874	100.0

3.6 Non-Degree Respondents

The preceeding five sections of this chapter have dealt with the personal characteristics of the total population of engineers and scientists laid off in the San Francisco Bay Area. As has been shown, non-degree individuals constitute approximately one-fourth of the total population of engineers and scientists employed by the nation's defense industries. A search of the literature shows that a great deal of information is available concerning graduate engineers and scientists, but little is known concerning the non-degree individuals. In this section an attempt is made to understand the processes by which these individuals achieve their professional status and to analyze their salient personal characteristics.

3.6.1 Process of Achieving Engineering or Scientific Status

The data show that a large number (46.4 percent) of the non-degree respondents began their engineering or scientific careers as technicians and, over the years, worked their way up to the positions from which they were laid off during the period under consideration. Fourteen percent of the non-degree subjects started as technical assistants, 8.4 percent as administrative assistants, and the remaining 31.2 percent began their careers in manners different from the ones specified above.

Table 16 shows the methods of achieving professional status for individuals in different age categories. An examination of this table reveals that age does not have a strong influence upon the manner in which non-degree individuals obtain engineering or scientific status. It should be noted, however, that as age goes down the percentage of those who started their careers as administrative assistants also goes down.

TABLE 16

METHODS OF ACHIEVING PROFESSIONAL STATUS FOR DIFFERENT AGE CATEGORIES (NON-DEGREE RESPONDENTS)
N = 250

Age	Started as a Technician N = 116	Started as a Technical Assistant N = 35	Started as an Administrative Assistant N = 14	Others N = 78	Total
56 years and above N = 35	34.2%	14.3	14.3	37.2	100.0
46-55 N = 77	43.0	10.4	10.4	36.2	100.0
36-45 N = 92	54.3	14.2	6.5	25.0	100.0
35 years or less N = 46	45.6	19.6	4.3	30.5	100.0

In order to determine the methods prevalent among non-degree individuals for achieving professional status in various areas of specialization, Table 17 has been constructed. It appears that relatively more electrical and mechanical engineers begin their careers as technicians. A majority of chemists and chemical engineers start out as technical assistants. In the five areas of specialization considered, "starting out as a technician" is by far the most commonly used method by the non-degree engineers and scientists for achieving professional status.

TABLE 17

METHODS OF ACHIEVING PROFESSIONAL STATUS FOR DIFFERENT AREAS OF SPECIALIZATION (NON-DEGREE INDIVIDUALS)

N = 210

Areas of Specialization	Started as a Technician N = 98	Started as a Technical Assistant N = 33	Started as an Administrative Assistant N = 13	Others N = 66	Total
Electrical Engineers N = 67	56.8%	20.9	4.5	17.8	100.0
Mechanical Engineers N = 86	46.5	12.8	3.5	37.2	100.0
Industrial Engineers N = 25	36.0	16.0	28.0	20.0	100.0
Aeronautical Engineers N = 32	34.3	12.5	0.0	53.2	100.0

The method which a non-degree engineer or scientist used for achieving his professional status has a strong bearing on his salary. Individuals who used methods other than the three listed in Table 17 received higher salaries than "others." An examination of the data shows that as the salary goes down, the percentage of individuals starting out as technicians and technical assistants goes up. In the case of individuals who began their careers as administrative assistants, the results are quite the contrary. It can, therefore, be inferred that non-degree individuals who start out as administrative assistants receive relatively higher salaries.

3.6.2 Process of Achieving Competence in Engineering or Science

Attending college and/or a university and completing pertinent courses is the most commonly used method by non-degree professionals for achieving engineering or scientific competence. Table 18 shows comparative percentages for different methods used by non-degree individuals. Self-motivated reading and on the job practical experience are the second and the third most important means of achieving technical competence.

TABLE 18

METHODS USED FOR ACHIEVING COMPETENCE IN ENGINEERING OR SCIENCE (NON-DEGREE RESPONDENTS) N = 245

1. Attending college (university) and completing pertinent courses	32.1%
2. Reading books, magazines, and technical manuals	24.1
3. On the job practical experience	17.7
4. Attending technical institutes and/or trade schools	11.6
5. Completing correspondence, extension, or adult education courses	7.6
6. Completing courses and workshops offered at place of employment	6.0
7. Others	0.9
TOTAL	100.0

Table 19 shows age distribution for non-degree individuals who used the three most commonly used methods of achieving technical competence. It is evident that the percentage of respondents who attended college increases as the age decreases. On the other hand, the proportion of those who achieved technical competence by reading pertinent books and magazines decreases as the age decreases.

A relatively large number of electrical and mechanical engineers achieved technical competence by attending college (university) and completing pertinent courses. Furthermore, the order of importance of the three most commonly used methods remains the same for all areas of specializations except for chemists and chemical engineers. Fifty percent of the chemists and chemical engineers achieved technical competence by reading books, magazines, and technical manuals on their own. According to this data, non-degree individuals who achieved technical competence by reading books, magazines and technical manuals made relatively more original contributions when measured in terms of numbers of patents issued and number of technical publications.

TABLE 19

AGE DISTRIBUTION FOR INDIVIDUALS WHO USED THE THREE MOST IMPORTANT METHODS OF ACHIEVING TECHNICAL COMPETENCE (NON-DEGREE INDIVIDUALS)
N = 249

Age	By Attending College N = 80	By Reading N = 60	By on-the-Job Experience N = 44	Others N = 65	Total
56 years and above N = 36	19.8%	31.0	14.0	35.2	100.0
46-55 N = 76	21.7	27.6	28.2	22.5	100.0
36-45 N = 92	34.8	22.8	10.5	31.9	100.0
35 years or less N = 45	57.7	15.5	13.3	13.5	100.0

3.6.3 Personal Characteristics

Generally speaking, non-degree respondents, when compared with the total population of laid off engineers and scientists, are older and draw smaller salaries. As shown in Table 20, 14.3 percent of the non-degree professionals are 56 years of age or older, while only 9.4 percent of the total population of laid off engineers and scientists fall within the same age category. Whereas 43.8 percent of the non-degree respondents are in the 46 years or above category; only 29.3 percent of the total population falls within the same age classification.

TABLE 20

COMPARATIVE AGE DISTRIBUTION FOR NON-DEGREE RESPONDENTS

Age	Non-Degree Respondents N = 245	Total Population N = 858
56 years and above	14.3%	9.4%
46-55	29.5	19.9
36-45	38.0	38.1
35 or less	18.2	32.6
TOTAL	100.0	100.0

When salary distribution is considered, it is found that non-degree individuals were relatively lower paid than the total population of laid off engineers and scientists. For instance, while 17 percent of the non-degree respondents had pre-layoff salary of $12,000 or more, 27 percent of the total population falls within the same salary bracket. Furthermore, the sample of non-degree respondents contains a relatively larger proportion of mechanical, aeronautical, and industrial engineers. The percentages of electrical engineers among the non-degree respondents and the total population of laid off engineers and scientists does not differ appreciably.

3.7 Summary

The single criterion on which the population of laid off engineers and scientists differs from the population of working engineers and scientists is their age. Defense-oriented firms in the San Francisco Bay Area appear to have laid off workers primarily on the basis of their age. When educational background, technical publications, patents, membership in professional societies, and number of engineering and scientific courses completed are considered there is no statistically significant difference between laid off and working engineers and scientists. Moreover, the older respondents completed relatively more additional technical courses since their last degree or diploma. Therefore, skill obsolescence appears not to have been a criterion for layoff.

An analysis of the data concerning non-degree respondents shows that a large number (46 percent) of them began their engineering or scientific careers as technicians. The most important method by which these individuals achieved technical competence is by attending college and/or a university and completing pertinent courses. Self-motivated reading and on-the-job practical experience are the second and the third most important means of achieving engineering or scientific competence.

CHAPTER IV

THE LAYOFF EXPERIENCE

This chapter discusses the manner in which engineers and scientists were laid off by 62 defense-oriented firms located in the San Francisco Bay Area. It deals with pertinent details of the pre-layoff jobs of the respondents and examines the layoff policies of the firms involved. It also reports the opinions of the respondents concerning utilization of their technical capabilities at their pre-layoff jobs and analyzes the possible effects of such opinions on the timing of their layoff.

4.1 Nature of the Pre-layoff Jobs

Approximately half (51 percent) of the laid off engineers and scientists, prior to their layoffs, were engaged in aerospace work; twenty-nine percent were in electronics; and the remaining twenty-eight percent were working on other assignments. It is not possible to provide details regarding the "other assignments" category because of the unavailability of such information.

The median yearly salary for the laid off engineers and scientists was found to be $10,475; 27 percent earned $12,000 or more, 30 percent received between $10,000 and $11,999, and 32 percent obtained salaries which ranged from a minimum of $8,000 per year to a maximum of $9,999 per annum.

The industrial experience of the subjects appears to be the most significant determining factor in regard to their salaries. When linear correlation coefficients are computed between salary and other variables, the highest coefficient (.55) is obtained for industrial experience. Individuals with longer experience have higher pre-layoff salaries. This relationship is significant at the .001 level (N = 874).

The age of the respondents when considered separately, does not seem to be as strong a determining factor as the length of their industrial experience so far as pre-layoff salary is concerned. The correlation between salary and age is .33, which is itself highly significant. However, as one would expect, the age of the 876 laid off engineers and scientists correlates very strongly with their experience, the product moment coefficient being .72. The data show that after 45 years of age, the earnings of laid off engineers and scientists tend to level off. For example, median salaries for respondents in the 56 years and older, 46 to 55 years, and 36 to 45 years categories are $11,364, $11,229, and $11,578 respectively. Moreover, the proportion of respondents in the $12,000 and above categories remains essentially the same for the above-mentioned three classifications based on age (Table 21). A further analysis of Table 21 shows that for the $10,000 to $14,999 salary bracket, the proportion of respondents increases as the age increases. A contrary trend is evident in the less than $10,000 salary classification.

TABLE 21

AGE VERSUS ANNUAL PRE-LAYOFF SALARY
N = 857

Age / Salary	56 Years or more N = 81	46 - 55 N = 171	36 - 45 N = 326	35 years or less N = 279
$15,000 or more N = 56	8.5%	9.5	8.9	1.4
$12,000 - $14,999 N = 170	23.5	26.8	26.4	6.8
$10,000 - $11,999 N = 260	47.0	35.7	35.0	16.8
Less than $10,000 N = 371	21.0	28.0	29.7	75.0
TOTAL	100.0	100.0	100.0	100.0

Table 22 gives median salaries for engineers and scientists in different areas of specialization. Chemists and chemical engineers received the highest pre-layoff salaries, mechanical engineers the second highest, and aeronautical engineers received the third highest salaries.

TABLE 22

MEDIAN ANNUAL SALARIES FOR DIFFERENT AREAS OF SPECIALIZATION

Specialization	N	Median Salary
Chemists and Chemical Engineers	68	$10,888
Mechanical Engineers	220	10,743
Aeronautical Engineers	70	10,676
Physicists	43	10,454
Electrical Engineers	248	10,328
Mathematicians	41	10,000

The educational background of the respondents seems to be an important, but not so strong a factor, in determining their salaries, as their industrial experience. For example, although the linear correlation coefficient for salary and educational background was a significant .24, this is not as impressive as the correlation of .55 for salary and industrial experience. In general, as the educational level goes up, the salaries of the laid off engineers and scientists increase correspondingly. For instance, the median yearly salaries for respondents with Doctor's degrees, Master's degrees, Bachelor's degrees, and no degree are $13,834, $11,767, $10,275 and $10,150 respectively. Table 23 gives additional support to this inference. As the educational level goes down, the percentage of those receiving $15,000 annual salary or more also goes down. A similar trend is evident in the $12,000-14,999 category. However, the proportion of those receiving less than $10,000 per year increases as the educational level decreases. Further examination of the data shows that number of patents issued (r = .23), membership in professional societies (r = .21), number of technical magazines read regularly (r = .20), number of courses taken at work (r = .12), and number of adult education and/or workshop courses in science or engineering (r = .10) all correlate positively with salary. It should be noted

TABLE 23

EDUCATIONAL BACKGROUND VERSUS
PRE-LAYOFF SALARY
N = 874

Education / Annual Salary	Doctor's degree N = 19	M.S. N = 99	B.S. N = 511	Non-degree N = 245
$15,000 or more	31.6%	15.2	5.7	2.4
$12,000 - 14,999	47.4	31.3	19.2	16.4
$10,000 - 11,999	21.0	30.3	28.4	33.9
Less than $10,000	0.0	23.2	46.7	47.3
TOTAL	100.0	100.0	100.0	100.0

that number of patents issued correlates positively (r = .19) with age; similarly, membership in professional societies has a positive correlation with education (r = .31).

4.2 Company Layoff Policies

In many countries of the world employers are required to obtain previous authorization from public authorities before dismissing or laying off employees. "In France, any employer who proposes to dismiss an employee is obliged to state his reasons to the manpower service."[30] In West Germany, in the event of a mass layoff, the employer is required to notify the regional employment office. "The law requires the employer to notify the works council (a statutory body elected by the workers to represent their interests in the plant) of the reasons for planned dismissals, and to solicit its opinion in the case of mass layoffs, both on the nature and number of dismissals which shall be effected and on means of avoiding hardships among the unemployed...."[31]

Similarly, legal advance notice provisions are a common feature in most European countries, and in Latin America, Africa, and Asia. "Regulations in many countries afford salaried employees, including professionals, technicians, and supervisory staff, earlier notice than production workers because they are often unprotected by collective agreements and find it more difficult to find employment."[32] Such regulations exist in countries, such as Austria, Belgium, West Germany, Greece, Italy, Peru, Poland, and Switzerland. In the case of production workers, minimum advance notice period is one month in the countries of France, Japan, and Ecuador, and two months in Argentina. For workers with considerable seniority, the advance notice period is even longer. Minimum advance notice period for salaried employees and certain professional categories is considerably greater in some countries; for example, three months in Belgium and six months after twelve years of service in West Germany.

4.2.1 Length of Advance Notice

The data collected in this study show that the 62 defense firms involved did not give a reasonably long advanced notice. The median length of advance notice for engineers and scientists laid off from the San Francisco Bay Area is 7.58 working days. Fourteen percent of the respondents were given no advance notice whatsoever. However, one-fourth of those with no advance notice were given severence pay. It is not possible to report the magnitude of the severence pay for those individuals. Table 24 shows the distribution of respondents for varying lengths of advance notice.

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[30] Bureau of Employment Security, U.S. Department of Labor, Experiences of Other Countries in Dealing With Technological Unemployment, BES No. ES-220, Washington, D.C., U.S.G.P.O., (August 1963), p. 27.

[31] *Ibid.*, p. 27.

[32] *Ibid.*, p. 28.

TABLE 24

LENGTH OF ADVANCE NOTICE
N = 820

1. None	13.9%
2. Up to 2 weeks	47.7
3. Between 3 and 4 weeks	26.6
4. Between 5 and 6 weeks	5.4
5. Between 7 and 8 weeks	1.5
6. More than 8 weeks	4.9
TOTAL	100.0

The data reveal that, generally speaking, respondents who had worked for their company for five years or more, received relatively longer advance notice (Table 25). For instance, 19.7 percent of those who had worked for their company five years or more were given advance notices of five weeks or longer. The similar percentage for those who worked for their firm for one year or less is only 8.4 percent. Moreover, only 4.9 percent of those with fives years or longer seniority received no advance notice as compared to 24.5 percent of those who had one year or shorter seniority. Further examination of the data shows that age, education, continuing educational activities, and industrial experience have no influence on the length of advance notice.

When managements of the defense companies were asked as to the reasons for the shortness of advance notice, invariably the answer was that it was not their fault. Since the Department of Defense did not give them much advance notice, they reported, how could they afford to keep so many workers on their payrolls. It should be noticed, however, that in certain cases, mass layoffs resulted not because of cancellation of any contract, but due to phasing out and completion of certain contracts. In such cases, management is normally aware of the termination date of the contract. In view of the long periods (Chapter V) of unemployment faced by engineers and scientists, a median advance notice of

TABLE 25

LENGTH OF ADVANCE NOTICE VERSUS NUMBER OF YEARS WITH THE COMPANY
N = 819

Advance Notice \ Number of years	More than 5 years N = 183	4-5 years N = 129	2-3 years N = 270	1 year or less N = 237
None	4.9%	12.4%	11.5%	24.5%
Up to 2 weeks	41.5	41.9	55.2	47.3
3 - 4 weeks	33.9	34.1	24.1	19.8
5 or more weeks	19.7	11.6	9.3	8.4
TOTAL	100.0	100.0	100.0	100.0

eight working days does not appear to be reasonable. One of the ways this problem could be alleviated is by liberalizing severence pay policies.

4.2.2 Leave to Look for a Job

As reported earlier, 86 percent of the respondents did receive some advance notice of their forthcoming layoffs. In order to investigate whether the respondents were given any leave to look for jobs, as well as an advance notice, further analysis was carried out. A total of 53 percent of the respondents received leave to look for a job with pay, and one percent without pay. The remaining 46 percent received no leave to look for a job. The data show that length of service with the company had no influence on whether an individual was given leave to look for a job. Further examination of the data reveals that larger firms were more liberal in granting leave to look for a job with pay than smaller firms.

4.2.3 Offer of a Substitute Job

In order to reduce the impact of layoffs on the professional technical community, some companies made available substitute jobs either in the same or in a different geographical area. Approximately six percent of the laid off engineers and scientists were offered jobs in the same geographical area, and 12 percent in locations other than the San Francisco Bay Area. The remaining 82 percent were offered no substitute jobs.

Table 26 shows the location of the substitute job for individuals with varying length of service with their companies. It is evident that a relatively large number of respondents with longer

TABLE 26

NUMBER OF YEARS WITH THE COMPANY VERSUS OFFER OF A SUBSTITUTE JOB

N = 848

Years with Company / Offer of Substitute Job	More than 5 years N = 190	4-5 years N = 135	2-3 years N = 280	1 year or less N = 243
In the Same Area	10.5%	8.9%	4.3%	4.9%
In a different area	17.4	14.1	13.6	5.8
No job offered	72.1	77.0	82.1	89.3
TOTAL	100.0	100.0	100.0	100.0

seniority were offered substitute jobs in the San Francisco Bay Area than respondents with comparatively less seniority. A similar trend is observable for the substitute jobs offered in areas other than the San Francisco Bay region. It can, therefore, be stated that as the length of service with the company decreased, the proportion of those who were offered a substitute job (in the same or a different area) also decreased. The trend is quite the contrary for the row entitled "no job offered" (Table 26). A further analysis of the data shows that relatively fewer individuals in the higher salary brackets ($15,000 and above) were offered substitute jobs.

Even though 18 percent of the laid off engineers and scientists were offered substitute jobs, only three percent accepted those substitute jobs. When asked as to their reasons for not accepting the substitute jobs, the respondents replied: did not want to relocate (55%); unstimulating work environments (10%); job was in a different area of specialization (7%); did not want to work in a defense company (13%); etc.

4.2.4 Time of Layoff

At the time of layoff, the median number of years that engineers and scientists had been working with their respective companies was 2.7; 23 percent had been working for more than five years, 16 percent for four-to-five years, 33 percent for two-to-three years, and the remaining 28 percent had been employed for one year or less. Table 27 shows the time of layoff for engineers and scientists with varying seniority with the company. It appears that length of employment with the company did not have an important effect on the time of layoff. Respondents who had been with their companies for five years or more were laid off at approximately the same rate as those that had been there two years or less.

TABLE 27

TIME OF LAYOFF VERSUS NUMBER OF YEARS WITH THE COMPANY (1964 LAYOFFS ONLY)

N = 775

Number of Years / Month Laidoff	More than 5 years N = 177	4-5 years N = 128	2-3 years N = 247	One year or less N = 223
January - April	32.2%	41.4%	38.5%	40.8%
May - August	45.2	35.2	38.0	31.4
September - December	22.6	23.4	23.5	27.8
TOTAL	100.0	100.0	100.0	100.0

On the basis of interviews with personnel managers of companies involved in defense layoffs, an impression was obtained that the least qualified (in terms of educational background, publications, patents, etc.) individuals were laid off first, and as more and more layoffs were forced upon companies, a few of the well qualified professionals had to be released. In order to establish the validity of this proposition, data was analyzed for several companies. The analysis shows that while this statement was valid for relatively small companies, the situation was quite the contrary with larger companies.

An examination of the data regarding educational background of respondents who were laid off at different time periods by company A (a relatively large company) shows that this firm laid off 75 percent of its Ph.D.'s during the first four months of 1964. However, only 38 percent of the non-degree individuals were laid off during the same period. When data concerning technical publications and patents is considered, individuals who were laid off during the first four months of 1964 had fewer than those laid off during the middle and/or last four months of 1964. Ten individuals (selected at random) who were laid off by company A were interviewed. The interviewees reported that company A laid off two types of individuals, (a) those who were technically less competent, and (b) those who were a threat to the immediate supervisor.

An analysis of the layoff data for respondents with different educational backgrounds who were laid off by company B (a relatively small company) reveals that, during the first four months of 1964, this company laid off proportionately fewer degree than non-degree individuals. The trend was similar during the middle four months of 1964. However, during the period September to December 1964, the company laid off a much larger percentage of degree than non-degree engineers and scientists. Individuals who were laid off during the last four months of 1964 have relatively more patents and a higher number of publications.

4.3 Underutilization of Technical Capabilities

During interviews with more than 150 laid off engineers and scientists, the author gathered the impression that a large number of them were not satisfied with their pre-layoff jobs. The reasons for this frustration, as reported by the subjects, was neither their working conditions nor their salaries. The interviewees felt that their technical capabilities were "mal-utilized." Consequently, the author felt that engineers and scientists who were not satisfied with their jobs might have appeared less competent to the management, and hence were the first to be laid off. As a result, a question was included in the questionnaire to determine the extent of this frustration allegedly caused by inappropriate or under-utilization.

The 876 respondents were asked the question: "While at your pre-layoff jobs, was your technical and scientific training utilized to the fullest extent?" Those who answered "no" to this question were asked to explain their reasons for feeling under-utilized. The data show that 59 percent of the laid off defense engineers and scientists felt that, at their pre-layoff job, their technical training was not utilized to the fullest extent. When asked to state the reasons for reporting under-utilization, the respondents replied as shown in Table 28.

TABLE 28

REASONS FOR UNDER-UTILIZATION OF TECHNICAL TALENT
N = 511

1.	Management policies discouraged full utilization	22.4%
2.	Was engaged in work different from what was trained for	21.7
3.	Unchallenging and unstimulating work	13.1
4.	Company needed a person with less education and training	12.7
5.	Too much administrative work--too many meetings	9.5
6.	Company did not need a technically trained person	8.4
7.	Job required skills in too narrow a specialization	5.2
8.	Others	7.0
	TOTAL	100.0

As regards the type of industry, relatively more aerospace engineers and scientists (61.4 percent) reported having been mal-utilized than the technical professionals engaged in electronics industries (56.3 percent). It was found that, irrespective of educational background, "work different from that trained for" and "poor management policies" were the two most commonly reported reasons for under-utilization of technical capabilities. More degree than non-degree respondents reported that their technical capabilities had been under-utilized (65.2 percent versus 44.6 percent). Scientists reportedly felt under-utilized more often than engineers (mathematicians 67.5 percent, chemists 67.2 percent, physicists 60.0 percent). Aeronautical engineers indicated the least under-utilization (41.4 percent). Furthermore, individuals who have to their credit three or more patents felt relatively more under-utilized than others (68.7 percent versus 59.0 percent). Respondents who have published two or more technical papers reported more under-utilization than others (68.1 percent as against 57.5 percent).

Further analysis of the data shows that a greater proportion of the respondents who reported under-utilization were laid off during the first four months of 1964 than the respondents who did not report under-utilization. An opposite trend was observed for the last four months of 1964. When subjects who reported under-utilization are considered separately, the data exhibit that a comparatively larger percentage of engineers and scientists (44 percent) who blamed their under-utilization on "poor management policies" and "need of a non-technical person" were laid off during the first four months of 1964. When all 1964 layoffs are considered, only 36 percent were laid off during these four months.

4.4 Summary

Engineers and scientists in the San Francisco Bay Area were not given a reasonably long advance notice of their pending layoffs. Half of the respondents were given advance notice of 7.58 working days or less. Fourteen percent of the subjects received no advance notice whatever. Although at the time of layoff, half of the engineers and scientists had been working for their employers for 2.7 years or more. Furthermore, 72 percent of the respondents had worked for their companies for more than one year.

Analysis of the data for individual firms shows that while relatively small companies laid off the least qualified (in terms of educational background, publications, patents, etc.) engineers and scientists first; no such trend was observed for larger companies. Seniority of the respondents had no influence on their time of layoff. Subjects who had been with their employers for five years or longer were laid off at approximately the same rate as those who had been with their firms for two years or less.

A majority (59 percent) of the laid off engineers and scientists reported that, at their pre-layoff job, their technical training was not fully utilized. A greater proportion of the subjects reporting under-utilization were laid off during the first four months of 1964 than subjects not reporting under-utilization.

The median salary for the laid off engineers and scientists is $10,475. Industrial experience is found to be the most significant determining factor as far as annual salary is concerned. The longer the experience, the higher the salary. Age and educational background of the respondent also correlates strongly with their salaries, but the linear correlation coefficients are much smaller than that for industrial experience.

CHAPTER V

THE UNEMPLOYMENT EXPERIENCE

The fact that engineers and scientists, like blue collar workers, can also be faced with unemployment and re-employment problems has been recognized only during the last few years. Up until then the continuous concern exhibited about the shortage of engineers and scientists had made people believe that it was almost impossible for an engineer or a scientist to be without a job. A search of the current literature shows that there is a divergence of opinion among experts concerning the present and the future supply and demand of engineers and scientists.

On the one hand, the most recent projections by the Engineering Manpower Commission of the Engineers Joint Council Inc. show that presently there is a gap of approximately 400,000 men between the nation's supply and demand for engineers. The EMC predicts that by 1975 this gap will increase to 600,000 engineers.[33] It should be noted, however, that the present and the projected gaps as estimated by the Engineering Manpower Commission consider only college graduates in the engineering job market. These projections do not take into account the non-degree individuals who constitute 25 to 30 percent of the nation's supply of engineers. If the existing and the future supplies of non-degree engineers were to be considered, the estimated gaps could be reduced by 300,000 for 1966, and by 420,000 for 1975.

On the other hand, many authors have provided hard evidence of a surplus of engineers and scientists in various parts of the country. In a recent report on the Dyna-Soar contract cancellation, it was pointed out that during 1964, 1300 professionals in the Seattle area remained unemployed for an average of 12 weeks.[34] A recent study on engineering and scientific layoffs in the Boston area showed that, on the average, unemployment for the entire sample was 9 weeks.[35]

Commenting on the shortage or overage of engineers and scientists in the country, a working group of the Defense Industry Advisory Committee stated:

> A question asked of the group was: do you have any shortages of scientific and engineering manpower? If so, what kind? Invariably, the answer would be: yes, we have shortages of good structures analysts, or systems managers, or mathematicians, or advanced degree people in particular fields. We could certainly use more; we can't hire them.

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[33] Walter Matthews, "Wanted: Engineers to Fill Growing Gap," Electronic News, Vol. 11 (December 26, 1966), p. 4.

[34] Robert Brandwein, The Dyna-Soar Contract Cancellation--A Statistical Summary, U.S. Arms Control and Disarmament Agency, Washington D.C. (July, 1965).

[35] Mooney, op. cit., p. 67.

But if the question posed was: are you experiencing an overall shortage of scientists and engineers? Do you have to subcontract work out or reject work because you don't have the requisite skills in your organization? Here the answer was firm and definite no: No, certainly not! We've never had any difficulty in hiring just engineers since the mid 1950's (some members said not even then). Nobody admitted to any overall shortage; some even spoke of a possible overage in the future. One member remarked that his company was a bit embarrassed to find that after pressuring the local universities to produce more scientists and engineers in the 1950's, it was now unable to provide jobs for them.[36]

Contributing to the further understanding of the dynamics of the supply and demand for engineers and scientists, this chapter discusses the unemployment experiences of the respondents who were laid off from 62 defense-oriented firms located in the San Francisco Bay Area. It deals in great detail with the factors affecting the period of unemployment. It also examines the adequacy of the sources of financial assistance that were available to the subjects during their period of unemployment.

5.1 Length of the Unemployment Period

The median period of unemployment for engineers and scientists who were laid off in the San Francisco Bay Area is 12 weeks. Approximately 22 percent of the respondents remained unemployed for less than four weeks; 26 percent for five-to-ten weeks; 21 percent for 11-to-17 weeks; and the remaining 31 percent were out of jobs for 18 weeks or longer. Furthermore, 6 percent of the laid off engineers and scientists were unemployed for one year or longer.

In considering the length of time a laid off engineer or scientist remained unemployed, it was felt that the most important variable would probably be his technical competence, measured in terms of: formal educational background, publications, patents, readership of technical magazines, courses taken at work, adult education and/or workshop courses completed in engineering or science, and membership in professional societies.

For the purpose of analysis two-way tables were constructed for period of unemployment versus the above-mentioned seven variables. Table 29 presents the relationship between educational background and the duration of unemployment. Chi square tests on each of these seven tables show that the period of unemployment is independent of educational background (X^2= 15.4, df= 20), publications (X^2= 17.3, df= 18), patents (X^2= 21.8, df= 24), readership of technical magazines (X^2= 9.6, df= 15), courses taken at place of work (X^2= 32.4, df= 36), adult education and/or workshop courses completed in engineering or science (χ^2= 28.1, df= 36), and membership in professional societies (χ^2= 21.2, df= 24). When linear correlation coefficients are computed for period of unemployment and the seven variables, this inference is further substantiated--all of the coefficients are smaller than .051.

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[36] Defense Industry Advisory Committee, Implications of Continuing Education for Scientific and Technical Personnel, (May 1964).

TABLE 29

PERIOD OF UNEMPLOYMENT VERSUS EDUCATIONAL BACKGROUND
N = 693

Education / Period of Unemployment	M.S. or higher degree N = 80	B.S. N = 407	Non-degree N = 206
4 weeks or less	25.0%	19.9%	24.3%
5-10 weeks	23.7	27.1	24.7
11-17 weeks	15.0	23.3	18.0
18 weeks or more	36.3	29.7	33.0
TOTAL	100.0	100.0	100.0

A further analysis of the questionnaires shows no relationship between an individual's area of specialization and the length of time he remained unemployed. The pre-layoff salary of the respondents, as given in Table 30, has also no influence upon their period of unemployment.

TABLE 30

PERIOD OF UNEMPLOYMENT VERSUS PRE-LAYOFF SALARY
N = 694

Pre-Layoff Salary / Period of Unemployment	$15,000 or more N = 46	$10,000-$14,999 N = 333	$8,000-$9,999 N = 229	Less than $8,000 N = 86
4 weeks or less	26.0%	18.0%	24.9%	25.6%
5-10 weeks	15.2	25.2	26.6	32.6
11-24 weeks	34.8	33.1	27.5	24.4
More than 24 weeks	24.0	23.7	21.0	17.4
TOTAL	100.0	100.0	100.0	100.0

Another aspect which was examined for relevance to the period of unemployment was that of number of job applications submitted. It was felt that perhaps those who found jobs earliest did so because they applied for a great many positions. Conversely, it was considered that one factor in lengthy unemployment might be personal apathy manifesting itself in little initiative in submitting job applications. The data show that this was not the case. On the contrary, it was found that respondents who remained unemployed for a longer period submitted more applications. A product moment correlation coefficient of .375 is obtained for period of unemployment and number of job applications submitted. This is significant at the .001 level.

Another variable which needs to be considered when analyzing the length of the unemployment period is the month during which the individual was laid off. The hypothesis was that persons laid off at an earlier date were more likely to have an easier time finding jobs. It was reasoned that as more people became unemployed, the competition for jobs increased and whatever jobs were available became filled. This hypothesis was rejected at .05 level of significance.

5.2 Effect of Age on Unemployment

The findings of section 5.1 are surprising, because employers apparently were not concerned with the educational background, or other technical capabilities of the laid off engineers and scientists. It can be recalled that Chapter III showed that, when selecting individuals for layoffs employers seemed not to have taken into consideration the technical capabilities of the respondents. At that point, it was observed that as far as educational background, patents, publications, and membership in professional societies were concerned, there was no statistically significant difference between laid off and working engineers and scientists. The only difference was that the laid off individuals were relatively older.

Detailed analysis of the data makes it evident that age of the respondents is the most significant factor in determining their period of unemployment. The older the subject, the longer the period of unemployment. Table 31 gives the period of unemployment for engineers and scientists in different age brackets. It can be observed that as age increases, the proportion of those who remained unemployed for 18 weeks or longer also increases.

For further examination of the data, several multiple regression analyses were carried out. Firstly, in the case of all the respondents, forward step-wise regression was computed with period of unemployment as the dependent variable and age, industrial experience, and pre-layoff salary as independent variables. The computations show that the highest regression coefficient (.285) was obtained for age, the next highest for industrial experience (.078), and the third highest for salary (.051). The regression coefficients for age and industrial experience are significant at the .01 level, but the regression coefficient for salary is not significant.

TABLE 31

AGE VERSUS PERIOD OF UNEMPLOYMENT
N = 682

Age / Period of Unemployment	46 years or older N = 201	36-45 years N = 260	35 years or less N = 221
4 weeks or less	18.9%	17.4%	29.4%
5-10 weeks	17.9	30.0	29.0
11-17 weeks	20.5	24.2	15.4
18 weeks or more	42.7	28.4	26.2
TOTAL	100.0	100.0	100.0

The positive signs for the two significant coefficients mean that the period of employment increases as age and industrial experience increase. It should be noted that age and industrial experience are highly interdependent. When linear regression is performed with industrial experience as the dependent variable and age as the independent variable, a regression coefficient of .74 is obtained. This coefficient is significant at the .001 level.

The findings of the present study, up to this point, have indicated that to avoid being laid off and to secure re-employment quickly in case of layoff, the only thing engineers and scientists can do is to stop growing old. This is indeed a discouraging finding. In order to determine if there was anything that could counteract the dysfunctional effects of old age, further analysis of the data was conducted.

As a first step the respondents were separated into four groups depending upon their formal degree. No further analysis was conducted for the group of 19 subjects with Doctor's degrees, because of the small N. In the case of the three remaining groups--step-wise forward regression was carried out separately, with period of unemployment as the dependent variable in each case. The three independent variables considered were age, industrial experience, and pre-layoff salary.

The results show that as the degree level goes up, the influence of age on the period of unemployment decreases continuously. For Master's degree holders, for instance, age does not have any significant effect on the length of employment. However, for non-degree individuals age is the most important factor in determining their period of unemployment. Holders of Bachelor's degrees occupy an intermediate position with respect to the influence of age upon the duration of unemployment.

It appears, therefore, that one way of combating old age is to obtain a higher degree, preferably a graduate degree.

In the case of the non-degree respondents the regression of age upon the above-mentioned three independent variables yielded the following coefficients: for age, .497; for salary, .308; and for industrial experience, .193. All three coefficients are significant at the .01 level. Since all three coefficients have positive signs, it is clear that the period of unemployment increases with increases in age, in industrial experience, and in salary.

For engineers and scientists with B.S. as the highest degree, forward step-wise regression with period of unemployment as the dependent variable gave rise to regression coefficients of .138 for age, .078 for salary, and .031 for industrial experience. The regression coefficient for age is significant at the .01 level, but the remaining two coefficients are not significant in this case.

With respect to the group of Master's degree holders, the stepwise regression procedure produces the highest coefficient (-.607) for the independent variable of salary. This is significant at the .01 level. The negative sign of the coefficient means that Master's degree respondents with lower salaries had higher periods of unemployment. This result deviates from those obtained for non-degree respondents, B.S. degree holders, and for the total population of laid off engineers and scientists. The next highest regression coefficient in this case is for industrial experience (.30); for age the coefficient is .042. The regression coefficient for industrial experience is significant at the .05 level, but that for age is not significant.

5.3 Effect of Job Search Methods and Home Ownership on Unemployment

When the methods by which the respondents obtained their post-layoff jobs are considered, it is found that subjects who procured their jobs by direct applications to firms suffered relatively shorter periods of unemployment. Table 32 shows the methods which secured the post-layoff jobs versus the period of unemployment. The hypothesis that the length of unemployment is independent of the method which procured post-layoff job was rejected at the .05 level of significance.

Since age was earlier found to be the most significant factor in determining the length of unemployment, two-way tables were constructed for age and the method which procured the post-layoff jobs and for age and the methods used in searching for a job. Chi square tests on both of these tables reveal that both the method used for obtaining the post-layoff jobs (X^2=34.8, df=42) and the methods used for job search (X^2=35.16, df=63) are independent of age.

TABLE 32

PERIOD OF UNEMPLOYMENT VERSUS METHOD WHICH PROCURED THE POST-LAYOFF JOB

N = 594

Method / Period of Unemployment	Direct Applications N = 142	Friends or Personal Contacts N = 163	Newspapers N = 108	Others N = 181
Less than 4 weeks	28.8%	23.2%	16.6%	21.5%
5-10 weeks	36.0	27.0	26.6	24.2
11-24 weeks	20.4	33.2	39.0	34.8
More than 24 weeks	14.8	16.6	17.8	19.5
TOTAL	100.0	100.0	100.0	100.0

The data concerning period of unemployment was further studied for the effects of home ownership. It was felt that respondents who owned their home might have felt reluctant to relocate and, as a result, suffered longer periods of unemployment. On the basis of the chi square test ($X^2 = 15.44$, df= 18) it was concluded that home-ownership had no influence on the length of unemployment. As will be shown in Chapter VI, home-ownership also had no influence on the geographical regions where job applications were sent by the subjects.

5.4 Sources of Financial Assistance

Unemployment insurance, severence pay, and liquidation of investments and/or savings were the three most frequently used sources of financial assistance by the laid off engineers and scientists in the San Francisco Bay Area. Table 33 shows the percentages of respondents which used various sources of fiscal support during their period of unemployment. The figures in this table include multiple sources used by some respondents.

In addition to indicating all sources of financial support, the respondents were requested to give the order of importance for the three most helpful sources. The scores for the most important and the second most important sources were combined and a composite ranking was obtained. Table 34 reports the ranks of various sources based on this composite score. An examination of Table 34 reveals that unemployment insurance was not only the most frequently used source of financial support, it was also the most important source. Similarly, severence pay and liquidation of investments and/or savings were the second most and the third most important sources, as well as the second most and the third most commonly used sources of financial assistance.

TABLE 33

SOURCES OF FINANCIAL ASSISTANCE USED DURING UNEMPLOYMENT

N = 700

1. Unemployment Insurance	73.7%
2. Severence Pay	68.4
3. Savings and liquidation of investments	65.0
4. Spouse's paycheck	21.5
5. Funds from pension plan and/or early retirement fund	8.8
6. Assistance from relatives and friends	8.8
7. Loans	7.1
8. Income of other family member	0.8
9. Others	9.5

TABLE 34

RANKING OF THE SOURCES OF FINANCIAL ASSISTANCE USED (BASED ON THE COMPOSITE OF THE TWO MOST IMPORTANT SOURCES REPORTED)

N = 731

1. Unemployment Insurance	30.5%
2. Severence pay	26.4
3. Savings and liquidation of Investments	24.0
4. Spouse's paycheck	8.9
5. Funds from pension plan and/or early retirement fund	4.2
6. Loans	1.2
7. Assistance from relatives and friends	0.7
8. Income of other family members	0.4
9. Others	3.7
TOTAL	100.0

When the data is analyzed in regard to pre-layoff salary and the three most important sources of financial support, it is observed that as the salary level goes down, the relative use of unemployment insurance and severence pay goes up. On the other hand, as the salary level decreases, the comparative use of savings and liquidation of investments goes down. The order of importance for the three sources remains unchanged for respondents in the $10,000-11,999 and less than $10,000 yearly salary categories. But in the case of the $12,000 and above category, unemployment insurance and liquidation of investments and/or savings become equally important, and use of severence pay becomes third in rank.

In order to investigate relative shifts in the use of the three most important sources as the period of unemployment increased, Table 35 was constructed. This table reveals that as the period of unemployment grew longer, the relative use, and hence the importance, of unemployment insurance increased.

TABLE 35*

PERIOD OF UNEMPLOYMENT VERSUS THE THREE
MOST IMPORTANT SOURCES OF FINANCIAL ASSISTANCE USED
N = 660

Sources of Financial Assistance / Period of Unemployment	4 weeks or less N = 146	5-10 weeks N = 172	11-24 weeks N = 195	More than 24 weeks N = 147
Unemployment Insurance	30.8%	78.6%	92.8%	100.0
Severence pay	75.4	72.6	67.6	49.0
Savings and Liquidation of Investments	51.4	64.0	72.8	75.0

*Based on multiple answers by respondents

In fact, all respondents who remained unemployed for more than 24 weeks used unemployment insurance. The use of severence pay decreased consistently as the period of unemployment increased. However, the use of savings and liquidation of investments increased with increase in the period of unemployment. It appears, therefore, that as the period of unemployment increased, the respondents exhausted their severence pay and depended more and more on unemployment insurance and liquidation of investments and/or savings. Even for those with period of unemployment less than 4 weeks, unemployment insurance and severence pay did not seem to be adequate. They had to dig into their savings right from the beginning.

A perusal of Tables 33 and 34 shows that spouse's paycheck was the fourth most commonly used, and also the fourth most important source of financial assistance. Prior to layoff, 26 percent of the respondents had their spouse employed full-time or part-time. After the layoff, an additional 5.5 percent had their spouse go to work for the purpose of financially assisting the family.

An examination of the data reveals that as the period of unemployment grew longer, spouses of more and more respondents accepted employment. An analysis of the personal characteristics of the respondents shows that as the salary level goes down, the proportion of those whose spouse went to work during the period of unemployment increases. It is observed that a much larger percentage of non-degree individuals had their spouse go to work during the period of unemployment than the respondents with Master's or Doctor's degrees.

The analysis presented so far has indicated that after layoff, a total of 32 percent of the respondents had their spouse working full-time or part-time. Why did the remaining 68 percent not use this source of possible financial assistance? In order to obtain an answer to this question, certain characteristics of those respondents whose spouse did go to work during the period of unemployment were compared with similar characteristics of those respondents whose spouse did not obtain employment during this period.

As far as age is concerned, there is no significant difference between the two groups. The data show that when the number of dependent children is considered there is no difference between the two groups. Further analysis reveals, however, that 92 percent of the respondents whose spouse went to work during the period of employment, had one other dependent in addition to their children. Most likely this other dependent was able to take care of the children and the other domestic work. Thus, it appears that the presence of a dependent able to care for the children enabled some of the spouses to go to work. Other spouses probably did not find it economically feasible to work, since they would have had to hire a domestic. In some cases they may not have been able to hire an appropriate one, even if they found it economically feasible.

5.5 Summary

The median period of unemployment for engineers and scientists who were laid off in the San Francisco Bay Area is 12 weeks; six percent of the respondents remained unemployed for one year or longer.

Age appears to be the most significant determining factor as far as length of unemployment is concerned. However, the influence of age on the duration of unemployment decreases with increase in the degree level. When respondents with Master's degrees are considered separately, pre-layoff salary seems to be the most significant factor. Individuals who earned lower salaries remained unemployed for longer periods of time. In the case of B.S. degree holders and non-degree subjects, age is the most important factor for predicting the period of unemployment. The older the person, the longer the duration of unemployment.

Home-ownership has no relation to the length of unemployment. Similarly, publications, patents, membership in professional societies, readership of technical magazines, courses taken at place of work, and adult education and/or workshop courses completed in engineering or science have no influence on the period of unemployment.

Unemployment insurance, severence pay, and liquidation of investments and/or savings were the three most important, and also the three most commonly used, sources of financial assistance by the laid off engineers and scientists in the San Francisco Bay Area. Respondents with lower pre-layoff salaries used unemployment insurance more often than respondents with higher salaries.

As the period of unemployment grew longer, the subjects exhausted their severence pay and depended more and more on unemployment insurance and liquidation of investments and/or savings. Even in the case of individuals who remained unemployed for four weeks or less, unemployment insurance and severence pay were not adequate. They had to dig into their savings from the very beginning.

During the period of unemployment, 32 percent of the engineers and scientists had their spouses working on a full-time or part-time basis. The presence of a dependent able to care for the children enabled some of the spouses to accept jobs during unemployment.

CHAPTER VI

JOB SEARCH ACTIVITIES

Involuntary job termination is not a pleasant experience for any worker. Specifically for scientists and engineers, the 1964 layoff period was a trying experience, because a great many of them were surplused at the same time. This meant extremely stiff competition for whatever positions were available. Since a large number of individuals were seeking employment simultaneously, it is likely that the methods used in looking for a job and personal or family characteristics became important variables in securing work. This chapter analyzes the questionnaires in order to illuminate the manner in which laid off defense engineers and scientists obtained re-employment and the factors which helped or hindered the process. An attempt is also made to determine the relative efficiency of the various job search methods used by the respondents.

6.1 Intensity of Job Search

As regards the number of job applications, 52 percent of the respondents submitted 25 or fewer; 24 percent submitted 26-50; 11 percent submitted 51-100; and 13 percent submitted more than 100.

In order to determine the influence of age on the number of job applications submitted Table 36 was constructed. This gives the percentages of respondents submitting a given number of job applications according to age. It can be observed that as age increases, the proportion of those making 25 or fewer applications decreases. A similar trend is evident for respondents who submitted 26-50 job applications. When the 51-100 and the more than 100 application categories are considered, the trend is quite the opposite. As age increases, the proportion of those who submitted more than 50 applications increases.

TABLE 36

AGE VERSUS NUMBER OF JOB APPLICATIONS
N = 815

Age / Number of Applications	46 years or older N = 234	36-45 years N = 316	35 years or less N = 265
25 or less	45.7%	49.7%	60.8%
26-50	21.4	24.0	25.3
51-100	12.9	12.7	7.9
more than 100	20.0	13.6	6.0
TOTAL	100.0	100.0	100.0

It is evident that older respondents submitted relatively more applications. This conforms with the earlier findings of Chapter V which showed that the older respondents remained unemployed for a longer period of time; hence, they were forced to submit more applications. It should be noted, however, that when data are broken down into two groups--those who transferred to non-defense work, and those who remained in defense work--different results are found.

For the group which transferred to non-defense work, the number of job applications submitted is independent of age (X^2= 34.66, df= 35). In the case of those who did not transfer to non-defense work, age has a strong influence on the number of job applications submitted. The older the respondent, the higher the number of job applications.

The educational background of the respondents does not have any effect on the number of job applications submitted (X^2= 27.4, df= 28). Even when the data are separated into two groups consisting of those who transferred to commercial jobs, and those who remained in defense jobs, the number of job applications submitted is independent of the educational background of the subjects.

Table 37 shows the number of engineers and scientists who sent job applications to various geographic regions. It can be seen that 84.6 percent sought employment in the San Francisco Bay Area; 53.5 percent sought employment within the State of California, but outside the San Francisco Bay Area; and 44.3 percent sought employment in the Far West (Pacific West and Mountain West).

One might expect that the geographical regions where job applications were sent would be affected by home ownership. It was found that 4.5 percent of the respondents owned their home completely; 61.5 percent owned their home partially; 8.2 percent were renting with a lease; and 23.5 percent were renting without a lease. An analysis of the data reveals that home ownership has no significant influence on the location where job applications were sent (X^2= 24.3, df= 26).

6.2 Unemployment Insurance and Job Search Efforts

In order to determine the effect of unemployment insurance on the job search activities of the laid off engineers and scientists, the data were separated into two groups: those who made use of the unemployment insurance (U.I.), and those who did not.

Comparison of these two groups reveals that a relatively higher proportion of those with U.I. submitted applications in the San Francisco Bay Area and the rest of the State of California than did those without U.I. Taking the number of job applications sent to all areas in the United States as a rough index of the initiative exerted by individuals in searching for work, persons utilizing U.I. appear to

TABLE 37

PERCENTAGE SUBMITTING JOB APPLICATIONS TO DIFFERENT GEOGRAPHICAL REGIONS

Geographical Region*	Percentage of Respondents**
San Francisco Bay Area	84.6%
California Outside S.F.B.A.	53.5
Pacific West	24.5
Mountain West	19.8
West South Central	19.4
Middle Atlantic	18.8
South Atlantic	18.8
New England	17.1
East North Central	13.0
East South Central	12.6
West North Central	10.3
Others	3.2

*See appendix for states included within each geographical region.

**Figure includes applications in more than one region by each respondent.

be more active than persons not utilizing U.I. It can be observed from the data that for every geographical region, the percentage of those with U.I. who submitted job applications is greater than the percentage of those without U.I. For the sake of illustration, a differential score has been computed by subtracting the percentage of those who did not use U.I. from the percentage of those who did use U.I. for respondents who sent job applications to different geographical areas. Table 38 gives the percentage difference between the two groups for job-applications submitted to various parts of the country. An examination of Table 38 shows that the percentage of U.I. users submitting applications exceeds the percentage for non-U.I. users in each region.

TABLE 38

PERCENTAGE DIFFERENTIAL BETWEEN NUMBER OF JOB APPLICATIONS BY PERSONS USING U.I. AND NUMBER OF JOB APPLICATIONS BY PERSONS NOT USING U.I. ACCORDING TO GEOGRAPHICAL REGIONS

N = 876

California (Outside S.F.B.A.)	29.8%
West South Central	18.4
San Francisco Bay Area	16.7
Pacific West	12.8
Mountain West	10.9
Middle Atlantic	10.8
East North Central	10.3
South Atlantic	9.9
West North Central	7.4
New England	7.1
East North Central	5.4

6.3 Methods Used to Obtain Post-layoff jobs

In a recent study of defense layoffs in the Seattle area, it was found that direct applications (32%) and friends and personal contacts (22%) were the two most commonly used methods for obtaining post-layoff jobs.[37] A similar study of engineering and scientific layoffs in the Boston area indicated that friends and personal contacts (27%) and private employment agencies (20%) were the two most frequently used means for obtaining re-employment.[38] According to a study on the dynamics of the defense R. & D. industry in the Los Angeles and Boston areas, the two most frequently stated reasons of engineers and scientists applying for work to a particular company were: personal acquaintance in company (51%), and knowledge of company's work in the respondent's field (17%).[39]

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[37] Brandwein, op. cit., p. 10.

[38] Mooney, op. cit., p. 152.

[39] Shapero, op. cit., p. 50.

TABLE 39

FREQUENCY OF USE AND "EFFICIENCY RATING" OF VARIOUS JOB SEARCH METHODS

N = 876

Job Search Method	Number of Individuals Who Used	Efficiency Rating
Direct Applications to Companies	656	13.0
Friends and Personal Contacts	615	11.4
Newspaper Advertisements	644	8.9
Out-place Services of Previous Employer	217	5.9
U.S. Gov't. (Civil Service) Representative	190	5.6
Private Employment Agencies	435	4.4
State of California Dept. of Employment	531	3.2
Services of Professional Societies	111	2.2
Trade and Professional Magazines	321	1.4

The data collected in the present study show that the three means which were most frequently used by the laid off defense engineers and scientists to look for jobs were: direct applications to companies; newspaper advertisements; and friends and personal contacts. The least frequently resorted to means were: services of professional societies; and U.S. Government (Civil Service) representatives. Since the respondents were requested to indicate the number of job offers obtained through the various methods of job search, it was possible to derive an "efficiency rating" by dividing the number of job offers into the total number of applications submitted using a particular job search method. This gives the number of job offers received per application, through different means of seeking employment. In order to avoid zeros on the right hand side of the decimal points, the figures obtained were multiplied by 1000. The results are shown in Table 39, where "efficiency rating" is represented as number of job offers per thousand job-applications.

When the methods which procured the post-layoff jobs are considered, the "efficiency rating" corresponds rather closely with the three most important methods (Table 40). However, there is some variation in the rank order in Tables 39 and 40.

TABLE 40

PERCENTAGE WHO PROCURED POST-LAYOFF JOBS BY VARIOUS JOB SEARCH METHODS

N = 744

Job Search Method	Percentage Obtaining Job
Friends and personal contacts	30.5%
Direct applications to companies	22.7
Newspaper Advertisements	17.3
Private Employment Agencies	7.5
Out-place Services by Previous Employer	4.2
U.S. Gov't. (Civil Service) Representative	4.1
State of California Dept. of Employment	3.0
Services of Professional Societies	1.2
Trade and Professional Magazines	.3
Others	9.2
TOTAL	100.0

In analyzing the methods used to obtain re-employment by the laid off engineers and scientists, it is important to examine some of the variables which might have influenced their choice of means. Table 41 gives the distribution for the five methods most frequently used versus the age classifications of the respondents. A chi square test of Table 41 shows that the job search methods employed by the respondents are independent of their age (X^2=45.99, df=63).

The factor of education appears to be highly relevant for discriminating among the means utilized in looking for a job. The data show that Ph.D.'s use professional societies, trade journals, and private employment agencies to a greater extent than any other educational grouping. Ph.D.'s also use newspapers and friends and personal contacts to a lesser degree than other unemployed technical professionals. Non-degree respondents make use of the State of California Employment Service and friends and personal contacts more than those who have achieved higher educational levels. The non-degree individuals make the least use of professional societies, trade journals, and private employment agencies. Moreover, it is found that as the level of education increases, the use of professional societies, trade journals, and

TABLE 41

FIVE MOST FREQUENTLY USED JOB SEARCH METHODS VERSUS AGE

N = 859

Age / Job Search Method	56 yrs. or older N = 81	46-55 N = 171	36-45 N = 327	Younger than 35 yrs. N = 380
Direct Applications	18.6%	16.9%	17.0%	17.3%
Newspaper Advertisements	17.6	14.3	17.0	18.0
Friends and personal contacts	14.3	17.1	15.8	16.3
State of Calif. Dept. of Employment	14.7	13.9	14.2	13.4
Private Employment Agencies	11.1	10.3	11.4	12.1
Other	23.7	27.5	24.6	22.9
TOTAL	100.0	100.0	100.0	100.0

private employment agencies increases. As the level of education decreases, the use of both newspapers and the State of California Employment Service increases. There are no apparent trends as regards the use of direct applications to companies and friends and personal contacts.

An additional variable analyzed for its influence upon the choice of job search methods was the source of financial support during the layoff period. No relationship was found. The rank order of frequency of use of various job search methods remains the same within each category of financial assistance. Furthermore, the percentage of individuals utilizing particular means of looking for a job is approximately the same for individuals indicating different sources of financial support.

An analysis of the consequences of the three methods most frequently used to search for employment upon the salary of the post-layoff job shows that jobs found through friends and personal contacts seemed to provide a relatively greater percentage of individuals with a salary of $12,000 or above and a comparatively smaller percentage of persons with a salary less than $10,000.

6.4 Factors Helpful in Obtaining Re-Employment

When asked to identify factors helpful in obtaining a job after their 1964 termination; 24 percent of the respondents said industrial experience was the most helpful factor, 23 percent considered this to be the second most useful factor in procuring work. Nineteen percent felt that formal education and training contributed most in obtaining their new job, and 21 percent reported training and education to be the second most significant aid in seeking re-employment. Table 42 gives the distribution of responses for the two items most helpful in gaining employment.

TABLE 42

TWO MOST HELPFUL FACTORS IN OBTAINING POST-LAYOFF JOB
N = 806

Factor	1st. Most Helpful Factor	2nd. Most Helpful Factor
Industrial Experience	24.4%	23.2%
Formal Education	18.7	21.1
Willingness to Accept Cut in Salary	15.5	12.9
Willingness to Relocate	11.9	10.1
Willingness to Adjust to Different Type of Work	9.8	15.1
Recommendations from Friends	9.4	11.3
Others or Nothing in Particular	10.3	6.3
TOTAL	100.0	100.0

Combining the first and second most helpful factors provides a single rating score for the six items listed above. The rank order of usefulness in obtaining work then becomes as listed in Table 43. Industrial experience remains the most helpful factor, but the importance of formal education and willingness to relocate decreases.

TABLE 43

COMBINED RANK ORDER OF MOST HELPFUL FACTORS IN OBTAINING POST-LAYOFF JOB
N = 806

Rank	Helpful Factor
1	Industrial experience
2	Willingness to accept cut in salary
3	Willingness to Adjust to different type of work
4	Formal education
5	Recommendations from friends
6	Willingness to relocate

Further analysis of the data reveals that age of the respondents has no influence on the factor they reported to be most helpful in obtaining post-layoff employment, ($X^2=38.27$, df=49). In Table 44 the combined score is used for a comparison between degree and non-degree persons. It can be seen that, whereas, formal education is considered the most helpful by the former group; it is accorded fifth place by the latter group. Moreover, willingness to accept a cut in salary and to adjust to different type of work becomes more relevant for non-degree individuals.

TABLE 44

MOST HELPFUL FACTORS IN OBTAINING POST-LAYOFF JOB, DEGREE VERSUS NON-DEGREE INDIVIDUALS
N = 806

Factor	Degree N = 566	Non-Degree N = 240
Formal education	29.8%	9.9%
Industrial experience	28.1	22.4
Willingness to accept cut in Salary	15.8	21.2
Recommendations from friends	12.3	13.3
Willingness to adjust to different type of work	7.0	15.7
Willingness to relocate	3.5	7.9
Others or nothing in particular	3.5	9.6
TOTAL	100.0	100.0

6.5 Factors Which Restricted Job-Search Activities

In reply to the question: what made the search for re-employment most difficult following the 1964 termination, 35.5 percent of the laid off engineers and scientists cited lack of available jobs as the primary factor. An additional 23.8 percent listed this as the second most difficult problem in the way of re-employment. Only a few individuals indicated that they felt a handicap because of too long a period of unemployment (.5 percent said greatest difficulty, 1.2 percent said second greatest) or being too young (.6 percent said greatest difficulty, .5 percent said second greatest). Table 45 gives the percentages for the first most, and the second most difficult factors in obtaining jobs.

TABLE 45

TWO MOST IMPORTANT FACTORS WHICH MADE RE-EMPLOYMENT DIFFICULT

N = 845

Factor	1st Most Difficult Factor	2nd Most Difficult Factor
Lack of available jobs	35.5%	23.8%
Inadequate education	13.8	7.5
Too old	11.4	12.1
Too high salary in previous job	9.8	22.0
Inadequate industrial experience	6.5	11.5
Reluctant to move	6.5	13.4
Others or none	16.5	9.7
TOTAL	100.0	100.0

After combining the first and second items listed, the rank order of factors creating the most difficulty in securing employment becomes as shown in Table 46. Lack of available jobs is still the most important, and reluctance to move to a different geographical area is still the least important factor in making job search difficult. However, the reason of too high a salary in the previous job increases greatly in importance.

TABLE 46

COMBINED RANK ORDER OF FACTORS MAKING RE-EMPLOYMENT MOST DIFFICULT

N = 845

Rank	Factors Against Re-employment
1	Lack of available jobs
2	Too high salary in previous job
3	Too old
4	Inadequate education
5	Reluctant to move
6	Inadequate industrial experience

Using the combined score for a comparison of degree and non-degree respondents, it can be seen that inadequate education is the second most cited factor for the non-degree group (Table 47). Individuals with a B.S. or higher degree rated this as the fifth most important, although 12.7 percent apparently felt their formal education to be inappropriate. Higher percentages of non-degree laid off engineers and scientists had difficulty because of inadequate industrial experience or being too old. On the other hand, a larger proportion of degreed technical professionals experienced a problem due to reluctance to move to a different geographical area.

TABLE 47

FACTORS MAKING RE-EMPLOYMENT MOST DIFFICULT,
DEGREE VERSUS NON-DEGREE INDIVIDUALS
N = 845

Factor	Degree N = 605	Non-Degree N = 240
Previous salary too high	21.9%	18.4%
Lack of available jobs	20.0	26.4
Reluctant to Move	14.5	4.6
Too old	12.7	15.7
Inadequate formal education	12.7	21.5
Inadequate Industrial experience	1.8	4.6
Others or None	16.4	8.8
TOTAL	100.0	100.0

A comparison of Tables 43 and 46 shows that, whereas, industrial experience is felt to be the most helpful factor in obtaining reemployment; the lack of it is not thought to be the most difficult factor in obtaining post-layoff jobs. Willingness to accept a cut in salary and reluctance to do so are the second most helpful and the second most difficult factors in obtaining jobs. Willingness to relocate or reluctance to do so, and formal education are considered to be relatively less important factors in gaining employment.

6.5.1 Personal and Family Commitments

Another set of variables hindering the search for employment have to do with personal and family commitments. These obligations restrict efforts to obtain work irrespective of the conditions of the job market or individual capabilities. When asked to identify the three most pertinent items, 44 percent of the respondents said the most restrictive factor was "nothing in particular." Eighteen percent of the laid off engineers and scientists were bothered by the thought of leaving an area offering greater cultural and educational opportunities. This factor was cited by 24 percent or the subjects as being the second most restrictive, and by 18 percent as being the third most restrictive. As can be seen from Table 46 reluctance to move the children to new schools and request from the spouse not to change residence were also mentioned frequently.

TABLE 48

THE TWO MOST RESTRICTIVE FACTORS IN OBTAINING POST-LAYOFF JOBS
N = 814

Factors	1st Most Restrictive	2nd Most Restrictive
Thought of leaving an area with greater cultural and educational opportunities	17.7%	24.0%
Reluctant to move children from school	8.6	13.3
Inability to sell house	5.5	5.6
Request from spouse not to move	5.4	13.2
Personal attachment to home	4.9	11.4
Reluctant to leave relatives	3.2	8.2
Reluctant to leave friends	1.8	8.8
Other ties or nothing in particular	52.9	15.5
TOTAL	100.0	100.0

Since the questionnaire provided for indication of the three most constraining items, all three answers have been included in deriving the combined rank order of the most restrictive factors given in Table 49. In this generalized rating, personal attachment to the home becomes the second most important inhibition and reluctance to move children into new schools decreases in relevance. Also, inability to sell the house appears to have a reduced impact.

TABLE 49

COMBINED RANK ORDER OF THE MOST RESTRICTIVE FACTORS IN OBTAINING POST-LAYOFF JOBS
N = 814

Rank	Restrictive Factors
1	Thought of leaving an area with greater cultural and educational opportunities
2	Personal attachement to the home
3	Request from spouse not to move
4	Reluctance to move children from school
5	Desire not to leave friends
6	Not wishing to leave relatives
7	Inability to sell the house

Comparison of degree and non-degree persons according to the combined score reveals little difference between the two groups. Degreed individuals seem to be slightly more sensitive to a request from the spouse and non-degree individuals appear to be somewhat more reluctant to leave relatives and friends. These percentages are small, however, as shown in Table 50.

6.6 Summary

Approximately half of the laid off engineers and scientists submitted 25 or more job applications. The older respondents, because of their longer periods of unemployment, submitted more job applications than the younger workers. The educational background of the subjects has no influence on the number of job applications.

Eighty-five percent of the engineers and scientists sought reemployment within the San Francisco Bay Area, 54 percent in other parts of California, and 44 percent in the Pacific and Mountain West regions. Home ownership does not have a significant effect on the location where job applications were sent. Respondents who made use of unemployment insurance are relatively more active in their job search efforts than subjects who did not make use of unemployment insurance.

TABLE 50

FACTORS RESTRICTING EFFORTS TO OBTAIN POST-LAYOFF JOBS, DEGREE VERSUS NON-DEGREE INDIVIDUALS
N = 814

Factor	Degree N = 578	Non-Degree N = 236
Attachment to home	29.9%	26.5%
Inability to terminate lease	15.5	15.5
Reluctant move children from school	11.3	9.8
Reluctant leave cultural & educational opportunities	11.3	9.4
Inability to sell house	6.2	6.3
Request from spouse not to move	4.1	2.9
Reluctant leave relatives	2.1	6.9
Reluctant leave friends	.0	2.2
Others or nothing	19.6	20.5
TOTAL	100.0	100.0

The three most frequently used methods for job search are: direct applications to companies (76%); newspaper advertisements (73%); and friends and personal contacts (70%). Sending direct applications to firms is the most efficient method of obtaining engineering and scientific jobs. On the average the respondents received 13 job offers per thousand job applications by this method. The second and the third most efficient methods are friends and personal contacts (11.4 job offers per 1000 applications), and newspaper advertisements (8.9 job offers per 1000 applications).

The methods used for job search are independent of the age of the respondents. However, the educational background of the respondents is a strong determining factor in the choice of job search methods used. The higher the educational level, the more frequent the use of professional societies, trade magazines, and private employment agencies. The lower the educational level, the higher the use of newspapers and of the California State Employment Service.

Industrial experience and willingness to accept a cut in salary are reported to be the two most helpful factors in locating re-employment. Lack of available jobs and reluctance to accept a cut in salary are considered by the respondents as the two most important factors which made job search efforts difficult. The thought of leaving an area offering greater cultural and educational opportunities and personal attachment to home are stated to be the two most restrictive factors in seeking post-layoff jobs.

CHAPTER VII

THE POST-LAYOFF EMPLOYMENT

The period of unemployment which engineers and scientists suffered as a result of defense layoffs and the subsequent job search activities have been discussed in Chapters V and VI. As of the 30th of November 1965, more than 90 percent of the respondents had obtained jobs either within or outside the San Francisco Bay Area. Where did these individuals find their jobs? Did they have to move to a different geographical location? If so, how were their moving expenses financed? Were there many engineers and scientists who had to accept cuts in their pre-layoff salaries? Did many individuals leave scientific and engineering fields to obtain employment? In the present chapter these and other related questions are discussed.

7.1 Nature of the Post-Layoff Job

Approximately 62 percent of the laid off engineers and scientists were able to locate re-employment within the San Francisco Bay Area; 17 percent found employment in other areas of California; and 21 percent had to leave the State of California in order to obtain jobs.

Table 51 shows percentages of respondents who obtained jobs in different regions of the United States. Outside of California it appears that a comparatively larger number of engineers and scientists secured re-employment in the South Atlantic, East South Central, and West South Central regions.[40] In fact, 90 percent of the respondents who migrated to these three regions found jobs in the states of Alabama, Florida, Georgia, and Texas.

In order to examine the relative salaries of engineers and scientists who obtained re-employment in different regions, the data were further analyzed. It is found that subjects who remained in California received relatively lower salaries than those who moved out to other regions of the United States.[41] The median salary for those who stayed in California is the lowest for the four regions considered. The median salary for respondents who found re-employment in California is $9,988, as compared to a median salary of $10,885 for all those who left California.

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[40] For the names of states included in each region please see Appendix D.

[41] As stated in Section 7.3, individuals who left California were relatively younger and better qualified and undoubtedly this influenced their receiving higher salaries.

TABLE 51

REGIONAL LOCATION OF POST-LAYOFF JOBS
N = 805

1. San Francisco Bay Area	61.6%
2. California (Outside of San Francisco Bay Area)	17.5
3. South Atlantic, East South Central, and West South Central	8.1
4. Pacific West and Mountain West	4.5
5. Middle Atlantic and New England	4.0
6. West North Central and East North Central	3.8
7. Others	0.5
TOTAL	100.0

Table 52 shows the salary increases and reductions received by respondents in different salary classifications. From Table 52, it can be observed that the lower the pre-layoff salary, the higher the proportion of those who received salary increases. An opposite trend

TABLE 52

SALARY INCREASES AND SALARY CUTS RECEIVED VERSUS PRE-LAYOFF SALARY
N = 785

Salary Change	$12,000 or above N = 204	$10,000-11,999 N = 238	$8,000-9,999 N = 243	Less than $8,000 N = 100
Received Salary Increases	11.3%	19.4%	24.6%	42.0%
No Change in Salary	51.9	47.9	52.7	51.0
Received Salary Cuts	36.8	32.7	22.7	7.0
TOTAL	100.0	100.0	100.0	100.0

is evident in the "received salary cuts" category. Thus, a relatively larger number of individuals with lower salaries received pay increases, while a comparatively larger number of higher paid individuals received salary cuts. Approximately half of the respondents obtained post-layoff jobs at the same salary as their pre-layoff jobs.

When past job history of the respondents is considered (Chapter VIII), it is observed that under normal circumstances, between 4 to 11 percent of the subjects received salary cuts. Subsequent to layoffs, however, this figure varied from 7 to 37 percent.

A total of 308 respondents had to relocate their household belongings in order to accept post-layoff jobs. In the case of 46 percent of these individuals the companies offering the job paid the moving expenses, for 12 percent the companies partially financed these expenses, and the remaining 42 percent relocated at their own expense.

TABLE 53

NATURE OF CHANGE FOR THOSE WHOSE POST-LAYOFF JOBS INVOLVED WORK DIFFERENT FROM THAT OF THEIR PRE-LAYOFF JOBS
N = 595

1. Different specialization	50.5%
2. Non engineering/scientific work	14.7
3. Shifted from management to technical work	6.9
4. Shifted from technical to management work	6.7
5. Transferred from research/development to production work	2.8
6. Transferred from production to research/development work	1.9
7. Moved from laison work to technical work	1.1
8. Others	15.4
TOTAL	100.0

Subsequent to their layoff, approximately 54 percent of the respondents obtained jobs involving non-defense work.[42] Furthermore,

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[42] For a detailed analysis of defense to non-defense conversion, see Chapter IX.

74 percent obtained jobs that involved work considerably different from what they were doing at their pre-layoff jobs. Table 53 shows the nature of change for those whose jobs involved a different type of work. Approximately 15 percent of these individuals reported that they were doing non-engineering/scientific work. These respondents were engaged in a wide variety of trades such as insurance, used car dealerships, real estate, etc.

7.2 Out-Migration of Engineers and Scientists from California

As has been stated earlier, nearly 21 percent of the laid off engineers and scientists left California in order to obtain their post-layoff jobs. Table 54 illustrates the age distribution for those who left California and for those who did not do so. An examination of Table 54 reveals that as the age of the respondents decreases, the proportion of those who left California increases. An opposite trend is evident for those who did not leave California. Hence, more younger engineers and scientists left California subsequent to their layoff.

TABLE 54

COMPARATIVE AGE DISTRIBUTION FOR THOSE WHO LEFT CALIFORNIA AND FOR THOSE WHO DID NOT DO SO

Age	Left California	Did not leave California	Total
46 years or more N = 214	14.0%	86.0	100.0
36 - 45 years N = 316	21.5%	78.5	100.0
35 years or less N = 262	26.0%	74.0	100.0

A further analysis of the data shows that more scientists than engineers left California. While only 19 percent of the engineers left the State, 36 percent of the scientists obtained their post-layoff jobs outside California.

In regard to educational background, proportionately more degree than non-degree engineers and scientists out-migrated from California. Whereas only 11 percent of the non-degree group left California; the corresponding percentage for the degree individuals is 25. When year of graduation is considered for the two groups: those who left California and those who stayed within the state; it is found that a comparatively more recent graduates moved out of California. From the group which graduated in 1960 or before, only 14 percent left California. But in the case of those who graduated after 1960, 30 percent moved out of the state.

Thus, engineers and scientists who left California in order to obtain their post-layoff jobs were younger, had a higher level of education, and had received their formal degrees more recently, than those who did not leave the state.

7.3 Engineers and Scientists Currently Unemployed

At the end of February 1966, a total of 63 laid off defense engineers and scientists were still without jobs. There were, in addition, 45 non-defense engineers who were unemployed. Twenty-four percent of the unemployed defense group consists of mechanical engineers; 22 percent are electrical engineers; 9 percent are industrial engineers; and the remaining 45 percent belong to other areas of specialization.

Table 55 shows the age distribution for the unemployed group and the other respondents. It can be observed that the unemployed engineers and scientists are relatively older. Thirty-five percent of the currently unemployed group is 56 years or older, and only 11 percent of them are in the 35 years or less category. Further study of the data indicates that the currently unemployed engineers and scientists received higher pre-layoff salaries and possess a lower educational background.

TABLE 55

AGE DISTRIBUTION FOR THOSE CURRENTLY UNEMPLOYED AND
THE OTHER RESPONDENTS
N = 859

Age	Currently Unemployed N = 63	Others N = 796
56 years and above	35.0%	7.0%
46-55 years	25.0	20.0
36-45 years	29.0	39.0
35 years and less	11.0	34.0
TOTAL	100.0	100.0

In regard to their job search activities, the currently unemployed group submitted a greater number of job applications than the others (Table 56). However, the methods of job search used by the two groups are quite different. Table 57 gives the relative use of the three most efficient methods of job search for the currently unemployed group and others. The most commonly used method by the currently employed group is the third most efficient method. Furthermore, only 65 percent of the currently unemployed group used the most efficient method.

TABLE 56

NUMBER OF JOB APPLICATIONS FOR THOSE CURRENTLY UNEMPLOYED AND THE OTHER RESPONDENTS

N = 811

Number of Applications	Currently Unemployed N = 63	Others N = 748
Less than 5	12.0%	19.0%
5-25	35.0	34.0
More than 25	53.0	47.0
TOTAL	100.0	100.0

TABLE 57

THE THREE MOST EFFICIENT METHODS OF JOB SEARCH (CURRENTLY EMPLOYED VERSUS OTHERS)*

N = 874

	Currently Unemployed N = 63	Others N = 748
The most efficient method: Direct Applications.	65%	82%
The second most efficient method: Friends and Personal Contacts.	47	78
The third most efficient method: Newspapers.	85	80

*Percentages based on multiple responses by some respondents.

An examination of the factors which made job search activities difficult for the unemployed group reveals that old age is the most critical factor for those currently unemployed. It should be noted that for the presently employed group, old age is the third most important factor which made job search activities difficult.

An investigation of the sources of financial support used during unemployment shows that unemployment insurance is the most important source of financial assistance for the currently unemployed, as is also the case for those presently employed. However, for the unemployed group, savings and liquidation of investments is the second most important source of financial support. In the case of others, severence pay is the second most important source of financial assistance.

7.4 Summary

Of the 876 respondents, 62 percent obtained re-employment within the San Francisco Bay Area; 17 percent found jobs in other parts of California; and the remaining 21 percent left the State in order to obtain their post-layoff jobs. Subjects who remained in California received relatively lower salaries (median = $9,988 per year) than those who moved out to other regions of the United States (median = $10,885 per year). The median salary for those remained in California is the lowest of all the geographical regions considered. In the case of those who relocated, firms offering re-employment paid moving expenses in full for approximately 46 percent of the respondents.

When salary changes are examined, it is found that the lower the pre-layoff salary, the higher the proportion of those receiving salary increases. The higher the pre-layoff salary, the more frequent the salary cuts.

Engineers and scientists who left California in order to secure their post-layoff jobs were younger, had obtained higher levels of education, and had received their formal degrees more recently than those who did not leave the State. Furthermore, more scientists than engineers out-migrated from California.

As of February 28, 1966, a total of 63 defense and 45 non-defense engineers and scientists were still unemployed. An analysis of the 63 defense engineers shows that the currently unemployed group is older and received higher salaries compared to those presently employed. It appears that the laid off defense engineers and scientists who are currently unemployed submitted a greater number of job applications but used relatively inefficient job search methods.

CHAPTER VIII

JOB HISTORY: JANUARY 1961 TO NOVEMBER 1965

This chapter deals with the 5-year job history of the respondents with the purpose of understanding the nature and the process of job changes among defense engineers and scientists. The data are examined in regard to the frequency of and reasons for job changes. An attempt is also made to obtain insights regarding the geographical mobility of engineers and scientists. In addition, some analysis is provided of the salary changes accompanying various job changes.

In a recent article on job tenure of American workers it was pointed out that:

> "for all workers, the average (median) number of years of continuous association with the same employer or business was 4.6 in January 1963, about a third higher than the 3.4 year average tenure noted in a comparable survey in 1951."[43]

In the case of defense engineers and scientists, however, the number of years of continuous association with the same employer appear to be relatively smaller. Albert Shapero, *et al*., have inferred that "the engineers and scientists of the defense R & D industry are highly mobile, with three-quarters of them having held two or more jobs."[44]

In another analysis of the geographically mobile group of engineers and scientists from the Boston area, Joseph D. Mooney has concluded that: "On the average the mobile group is slightly younger, higher salaried, and somewhat more skilled,..."[45] As was pointed out earlier in the present report (Chapter VII), approximately 38 percent of the laid off engineers and scientists left the San Francisco Bay Area. How mobile were these individuals prior to the 1964 layoffs? The present chapter is an attempt to answer this question.

8.1 Job Changes During 1961-65

A careful look at the data collected in this study reveals that, not counting the job change due to the most recent layoff, the laid off engineers and scientists had on the average 1.2 job changes during the 5-year period under consideration. The median number of job changes for the respondents is 1.48, which does not differ appreciably from the average number of job changes.

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[43] Harvey R. Homel, "Job Tenure of American Workers January 1963," *Monthly Labor Review*, U.S. Department of Labor, October 1963, p. 1145.

[44] Shapero, *op. cit*., p. 10.

[45] Mooney, *op. cit*., p. 119.

Table 58 shows the average number of job changes for respondents with different educational background and varying length of industrial experience. It appears that individuals with Doctor's degrees are the least mobile, and those with Bachelor's degrees have the highest average number of job changes. This finding differs from the results of another study according to which "... non-degreed engineers and scientists have the highest turnover..."[46] The present study indicates that non-degree engineers and scientists change jobs more often than engineers and scientists having Master's degrees and Doctor's degrees, but are less mobile than those with Bachelor's degrees. It should be noted that the median number of job changes for each educational classification is approximately the same as the average number of job changes. The maximum difference between the two figures is for Bachelor's degree holders, in which case the median is 1.58 as compared to the average of 1.36.

TABLE 58

AVERAGE NUMBER OF JOB CHANGES DURING 1961-65 VERSUS EDUCATIONAL BACKGROUND AND INDUSTRIAL EXPERIENCE

Educational background	Average number of job changes	Industrial experience	Average Number of job changes
Doctor's degree N = 19	0.89	15 years or longer N = 279	1.13
Master's degree N = 88	0.98	10-14 years N = 186	1.24
Bachelor's degree N=490	1.36	6-9 years N = 175	1.40
Non-degree N = 229	1.28	5 years or less N = 180	1.42

An examination of the influence of industrial experience on job mobility reveals that engineers and scientists with relatively shorter technical experience are more mobile than those with longer industrial experience. The median number of job changes for varying lengths of industrial experience does not differ appreciably from the average number of job changes, the maximum difference being between a median of 1.69 and a mean of 1.42.

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[46] Shapero, op. cit., p. 10.

TABLE 59

AVERAGE NUMBER OF JOB CHANGES DURING 1961-65 VERSUS AREA OF SPECIALIZATION AND POST-LAYOFF SALARY

Area of Specialization	Average number of job changes	Post-layoff salary	Average number of job changes
Mechanical engineers N = 212	1.45	$15,000 or more N = 54	1.01
Industrial engineers N = 76	1.36	$12,000-14,999 N = 143	1.03
Electrical engineers N = 233	1.32	$10,000-11,999 N = 198	1.20
Aeronautical engineers N = 65	1.03	$8,000-9,999 N = 206	1.48
Chemists and chemical engineers N = 64	1.01	Less than $8,000 N - 150	1.74
Others* N - 226	1.06		

*Includes more than 15 specializations each represented by a small number of respondents.

A comparison of different areas of specialization shows that mechanical engineers are the most mobile, while chemists and chemical engineers are the least mobile groups (Table 59). Aeronautical engineers appear to be nearly equal to chemists and chemical engineers in low mobility; whereas industrial engineers and electrical engineers occupy an intermediate position in the ranking of number of job changes. Table 59 demonstrates that the lower the salary level, the higher the number of job changes. In other words, the lower salaried engineers and scientists are much more mobile than the higher salaried individuals.

These data suggest that the most mobile engineer or scientist possesses a Bachelor's degree, has an industrial experience of less than 5 years, and earns less than $8,000 per year.

8.2 Reasons for Job Changes

Why are defense engineers and scientists relatively more mobile than other workers? Table 60 has been constructed to answer this question. It seems that salary increase is the most common reason for job changes with engineers and scientists. More interesting work and layoff for lack of work are the second and the third most common reasons for job changes. It should be observed that Table 60 gives reasons for job changes for the period January 1961 to December 1963 only. The reason "laid off for lack of work," therefore, does not include the most recent layoff. It appears that for 15.4 percent of the respondents, the most recent layoff was not a new experience. They had suffered similar involuntary termination before.

TABLE 60

REASONS FOR JOB CHANGES DURING 1961-63
N = 465

1. Higher salary	20.3%
2. More interesting work	15.3
3. Laid off for lack of work	13.6
4. Opportunity for advancement	12.4
5. Better geographical location	8.3
6. Desire to change	6.4
7. Better working conditions	5.2
8. Better cultural and educational opportunities	4.2
9. Job security	3.3
10. Location near relatives and/or close friends	2.1
11. Dismissed	1.2
12. Shorter commuting distance	1.1
13. Others	6.6
TOTAL	100.0

When Table 60 is compared with similar data obtained in another study concerning working defense engineers and scientists from the Los Angeles and Boston areas, it is found that the proportion of those who gave "laid off for lack of work (reduction in force)" as their reason for job changes is considerably higher (23.2%) for the sample of working engineers and scientists.[47] It should be noted that the data concerning working engineers and scientists was obtained from the existing interview records of 10 defense-establishments; whereas the data collected in the present study was obtained by a voluntary questionnaire. Further comparison of the data show that the proportions of those who changed jobs in order to move to a better geographical location, or because of shorter commuting distance are approximately the same for the laid off respondents and for working engineers and scientists in the Los Angeles and Boston areas. If 23.2 percent of the defense engineers and scientists who change jobs do so because of a reduction in force, this means that approximately one-fourth of the nation's defense industries turn-over rate is due to layoffs for lack of work.

8.3 Salary Changes

The inference that higher salaries is the most common reason for job changes is also supported by Table 61. From this table it can be observed that during the period January 1961 to December 1963, approximately 45 percent of those who changed jobs received salary increases, while only 10 percent received salary cuts. This situation changed drastically subsequent to the most recent layoffs. With the post-layoff

TABLE 61

SALARY CHANGES DURING 1961-65

Job / Change	First job change during 1961-63 N = 364	Second job change during 1961-63 N = 133	Job change due to layoff N = 785	First job change after the post-layoff job N = 267
Salary increase	45.6%	44.3%	21.0%	29.9%
No change in salary	44.8	45.8	50.8	58.4
Salary reduction	9.6	9.9	28.2	11.7
TOTAL	100.0	100.0	100.0	100.0

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[47] Shapero, op. cit.

employment, the proportion of those receiving salary increases was reduced to 21 percent and that of those receiving salary cuts increased to 28.2 percent. Moreover, for respondents who changed jobs once more after their post-layoff employment, the proportion of those receiving salary raises increased to 29.9 percent, and that of those receiving salary cuts decreased to 11.7 percent.

An analysis of Table 62 shows that during the period January 1961 to December 1963, a greater proportion of respondents in the lower salary brackets received pay increases. In general, as the salary level goes down, the proportion of those receiving salary increases goes up and that of those receiving salary cuts goes down.

TABLE 62

SALARY CHANGES FOR THE FIRST JOB CHANGE DURING 1961-63
N = 364

Salary / Change	$12,000 or more N = 77	$10,000-11,999 N = 69	Less than $10,000 N = 218
Salary increase	20.9%	43.5%	55.1%
No change in salary	53.1	44.9	41.7
Salary reduction	26.0	11.6	3.2
TOTAL	100.0	100.0	100.0

A similar trend is evident in Table 63, which shows the salary increases or decreases for the post-layoff job. The reader should note that percentages for cells in the salary increase column of Table 63 are approximately one-half of those in the corresponding cells of Table 62. Furthermore, the percentages in the salary decrease column of Table 63 are considerably higher than the corresponding percentages of Table 62. However, there is no significant change in the "no change in salary" columns of the two tables.

8.4 Geographical Mobility

In order to investigate patterns of geographical mobility for the laid off engineers and scientists, the data was broken down according to location of the jobs held during the period under consideration. Table 64 shows in- and out-migration of engineers and scientists from California during the 5-year period 1961-65. An examination of Table 64 reveals that prior to the most recent layoffs there was a heavy migration of engineers and scientists into California. But since the

TABLE 63

SALARY CHANGES FOR THE POST-LAYOFF JOB
N = 785

Salary / Change	$12,000 or more N = 204	$10,000-11,999 N = 238	Less than $10,000 N = 343
Salary increase	10.6%	19.4%	52.2%
No change in salary	52.0	47.9	28.3
Salary reduction	37.4	32.7	19.5
TOTAL	100.0	100.0	100.0

1964 layoffs, relatively fewer engineers and scientists have moved into the state. Not only has the migration into California decreased, out-migration from California has considerably increased. The largest number of moves were made within the State of California. A similar observation was made by another author concerning working engineers and scientists from the Los Angeles and Boston areas.[48] According to him, "by far the largest single fraction of moves among both the Los Angeles and Boston engineers and scientists occurred within the local areas."

TABLE 64

IN- AND OUT-MIGRATION OF ENGINEERS AND SCIENTISTS FROM CALIFORNIA DURING 1961-65

	First job change during 1961-63 N = 383	Second job change during 1961-63 N = 138	Job Change due to layoff N = 805	First job change after the post-layoff job N = 285
Came to California	29.7%	21.8%	0.0%	9.8%
Stayed in California	60.8	71.6	79.1	77.0
Left California	2.9	3.6	20.9	6.0
Others	6.6	3.0	-	7.2
TOTAL	100.0	100.0	100.0	100.0

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[48] Shapero, *op. cit.*, p. 38.

Tables 65 and 66 show the geographical sources and outlets of California's defense engineers and scientists. Table 65 illustrates in- and out-migration from California prior to the most recent layoffs. The Middle Atlantic and the New England regions appear to be the two most important sources of California's defense engineers and scientists. Further analysis indicates that the out-migration from California was neglible during the 1961-1963 period.

TABLE 65

IN- AND OUT-MIGRATION OF ENGINEERS AND SCIENTISTS FROM CALIFORNIA (FIRST JOB CHANGE DURING THE PERIOD 1961-63)

N = 357

	Location of second job during 1961-63	
Location of first job during 1961-63	Came to California from	Went from California to
California	67.1%	95.6%
Pacific West and Mountain West	8.1	1.6
South Atlantic East South Central West South Central West North Central East North Central	11.8	1.6
Middle Atlantic New England and Others	13.0	1.2
TOTAL	100.0	100.0

In Table 66 data are presented for in- and out-migration from California subsequent to the most recent layoffs. A comparison of Tables 65 and 66 reveals that subsequent to the 1964 layoffs, fewer engineers and scientists migrated into California. At the same time, out-migration of engineers and scientists increased from California. Moreover, subsequent to the layoffs, comparatively more engineers and came to California from the Southern, South Western, and Mid-Western states than from the Middle Atlantic and New England regions.

TABLE 66

IN- AND OUT-MIGRATION OF ENGINEERS AND SCIENTISTS FROM CALIFORNIA (FIRST JOB CHANGE AFTER POST-LAYOFF EMPLOYMENT)
N = 267

	Location of First Job After the Post-Layoff Employment	
Location of post-layoff job	Came to California from N = 247	Went from California to N = 236
California	88.8%	92.8%
Pacific West and Mountain West	2.0	3.4
South Atlantic East South Central West South Central West North Central East North Central	6.0	1.3
Middle Atlantic New England and Others	3.2	2.5
TOTAL	100.0	100.0

8.5 Summary

Not counting the job change due to the most recent layoffs, engineers and scientists on the average had 1.2 job changes during the five-year period January 1961 to November 1965. The median number of job changes during the same period is 1.48. Respondents with Bachelor's degrees are the most mobile when compared with subjects in other educational classifications. Mechanical engineers constitute the most mobile and chemists and chemical engineers the least mobile groups. The data suggest that the most mobile engineer or scientist possesses a Bachelor's degree, has an industrial experience of less than 5 years, and earns less than $8,000 per year.

The most common reason for which engineers and scientists change jobs is higher salary. Approximately one-fifth of the job changes during 1961-63 were made because of desire for higher salary. More interesting work (15%) and laid off for lack of work (14%) are reported to be the second most frequent and the third most frequent reasons for job change during 1961-63.

Under good business conditions, normally 45 percent of the engineers and scientists who change jobs receive salary increases. Under poor business conditions, this proportion drops to 21 percent. The proportion of those receiving no changes in salary varies from a low of 45 percent (under good business conditions) to a high of 58 percent (under poor business conditions). The proportion of those experiencing salary cuts varies from a low of 10 percent to a high of 28 percent. As the salary level goes down, the percentage of those receiving salary increases goes up, and that of those receiving salary cuts goes down.

Since the 1964 layoffs, the in-migration of engineers and scientists to California has slowed down and the out-migration has accelerated. The Middle Atlantic and the New England regions appear to be the two most important sources of California's in-migrating engineers and scientists.

CHAPTER IX

OCCUPATIONAL CONVERSION: DEFENSE TO COMMERCIAL WORK

9.1 Nature of the Problem

Much of the literature concerning the conversion of the defense industry and personnel to commercial work has emphasized the differences that exist both in the type of managerial skills and the technical personnel needed for defense and non-defense industries. Murray Wiedenbaum in his testimony before the U.S. Senate subcommittee on Employment and Manpower stated that "...the resources used by these industries for defense work are extremely specialized..."[49] He further added that the conversion of defense industry resources to peacetime pursuits would present a problem of major proportion. Professor Seymour Melman of Columbia University in a recent article has pointed out that: "The conversion of a high-technology-based military industrial system to a civilian economy involves a set of problems without precedent in American Society."[50]

In regard to occupational training and conversion Professor Melman comments:

> Managers and engineers of military producing firms have had extensive training in meeting the functional requirements of the Defense Department. These requirements do not usually include cost-minimization either in the design of the product or in the production system. Accordingly, if these men are to become competent in servicing the civilian market they must be retrained in the economies of design and in the economies of production engineering....
>
> Marketing men are another group in the defense-serving industries that will require extensive retraining, for these men have acquired the specialized experience of selling to the Department of Defense. This experience is far removed from the skills necessary to sell in the commercial-civilian market.[51]

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[49] Murray L. Wiedenbaum, The Transferability of Defense Industry Resources to Civilian Use, Testimony before the subcommittee on Employment and Manpower, Committee on Labor and Public Welfare, U.S. Senate (Nov. 21, 1965).

[50] Seymour Melman, "Key Problems of Industrial Conversion to the Civilian Economy," pp. 878-888 in Convertibility of Space and Defense Resources to Civilian Needs: A Search for New Employment Potential, U.S. Government Printing Office, Washington, D. C., (1964), p. 878.

[51] *Ibid*., p. 886.

Professor Ullman of Hofstra University has also emphasized the lack of cost consciousness in the defense industry. He states that, "Unfortunately, the arms industry is not noted for its efficiency and cost consciousness. It is no exaggeration to state that a whole generation of engineers and scientists has grown up in the belief that as long as a product is made right, and is delivered on time, cost becomes secondary."[52] These and other authors have indicated in clear terms the major difference between the operations and personnel needs of defense and commercial companies.

There are, however, a few individuals, such as Dr. Guy Black, who have indicated doubt as to the need of different requirements for engineers working for defense and commercial firms. In a recent article Mr. Black has remarked, "None of these viewpoints has been well documented, and I am personally skeptical that differences are as important as some claim them to be."[53] Some of the studies on engineering layoffs have produced evidence in support of Mr. Black's skepticism.

For example, the results of a recent study on engineering and scientific layoffs in the Boston area agree with Mr. Black's views. According to this study, 23 percent of those laid off engineers and scientists who were at that time re-employed, found jobs with commercial companies.[54] Similarly the Dyna-Soar Contract Cancellation Study concluded that "slightly less than one-third of the male respondents who were working in August and whose industry of employment was identifiable were employed in what is called the defense industry."[55] Therefore, two-thirds of these individuals were employed by non-defense companies. However, "there was a decidedly noticeable shift of male workers over 35 from the professional and semi-professional to the skilled worker classification."

On the other hand, according to the Industry Diversification Institute, unemployed defense engineers in the Los Angeles area had very little success with non-defense employers. In a recent proposal to the U.S. Department of Labor, the Industry Diversification Institute has stated that, "defense engineering attitude is suspect in terms of commercial adaptability. Almost literally it is 'No Defense Engineer Need Apply.'"[56]

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[52] John E. Ullman, "Problems of Occupational Conversion," pp. 675-690 in Convertibility of Space and Defense Resources to Civilian Needs: A Search for New Employment Potentials, U.S. Government Printing Office, Washington, D.C. (1964).

[53] Guy Black, "The Changing Market for Electrical Engineers," IEEE Spectrum (August, 1964), p. 74.

[54] Mooney, op. cit., p. 137.

[55] Brandwein, op. cit., p. 6.

[56] A Proposal for the Development of an Experimental Model for the Re-orientation and Re-employment of Displaced Defense Scientists and Engineers into Non-defense Industries, Industry Diversification Institute, Los Angeles, California (1959).

It is, therefore, clear that the literature contains conflicting evidence and relatively unsubstantiated views in regard to the feasibility of transferring defense engineers to commercial work. The two completed studies cited above do not answer the question as to how long these engineers stayed on non-defense jobs. Furthermore, neither of the two studies cited deal with personal characteristics, salary differentials, and other related items for the transferred defense engineers and scientists. In this chapter an attempt is made to discuss these and other related issues.

9.2 Shifts From Defense to Commercial Work During the January 1961 to November 1965 Period

An analysis of the 5-year job history shows that shifts from defense to commercial work have been prevalent among engineers and scientists throughout this period. During this interval, out of a total of 1,672 job changes, 629 (37.5%) involved shifts from defense to commercial type of work. Table 67 illustrates the defense to non-defense shifts represented as percentages of the total number of these who changed jobs during the 5-year period under consideration. On the basis of this table, it appears that shifts from defense to commercial work are certainly not a rare phenomenon. An extremely high rate (53.8%) of shifts subsequent to the recent layoffs shows that defense engineers and scientists are acceptable to commercial employers.

TABLE 67

TRANSFERS FROM DEFENSE TO COMMERCIAL JOBS
(January 1961 - November 1965)

Job Change	Number of job changes	Number of shifts from defense to Commercial work	Percent Shifted from Defense to Commercial work
First job change during 1961-63	383	64	16.6%
Second job change during 1961-63	138	23	13.6
Job change due to layoff	805	432	53.6
First job change after post-layoff job	285	90	31.5
Second job change after post-layoff job	61	20	33.3
TOTAL	1,672	629	37.5

Further analysis of the data reveals that large scale transfers to commercial work, subsequent to the recent layoffs, were not of a temporary nature. From the available information it was possible to compute the length of time at the commercial jobs as of November 30, 1965. This computation shows that 14 percent of those who transferred had been on their commercial jobs for 18 months or longer, 39 percent for 13-18 months, 29 percent for 7-12 months, and 18 percent for less than 6 months. The median duration of commercial jobs, as of November 30, 1965, is 13.5 months.

When the data are examined in regard to the number of engineers and scientists who transferred to commercial work, but later went back to defense firms; it is found that a relatively small proportion returned to defense work. As of Nobember 30, 1965, 84 out of the total of 432 who transferred had gone back to defense work. However, during the same period, an additional 48 engineers and scientists from the not-transferred group shifted to commercial engineering jobs. At the end of Nobember, 1965, there was a net of 396 (49.2%) defense engineers and scientists who had shifted to commercial work. This group of transferred respondents represents more than 30 different defense firms involved in the layoffs.

9.3 Shifts from Defense to Commercial Work Subsequent to the Most Recent Layoffs

All of the 432 respondents who shifted to commercial work were asked whether their work at the new job was different from what they were doing at their previous defense job. If so, they were requested to explain the salient differences. On the basis of respondents' replies to this question, it was possible to determine the nature of commercial jobs to which defense engineers and scientists transferred subsequent to their recent layoff.

Table 68 gives the nature and the location of commercial jobs. The transferred engineers and scientists were engaged in industrial gear design, automative engineering, industrial process control, commercial computer industry, medical electronics, research in printing machines and process, etc. It should be observed (Table 68) that approximately one-tenth of those who transferred to commercial work were engaged in non-engineering jobs. About half (20) of these individuals had started their own businesses and the remaining 23 took sub-professional jobs such as technicians, postal clerks, door-to-door salesman, gasoline station attendant, grocery clerk, etc. As of November 30, 1965, all of these 23 engineers and scientists had accepted jobs with defense-oriented firms.

In order to examine the influence of salary change on the length of time the transferred engineers and scientists remained on commercial jobs, the data were analyzed in greater detail. Table 69 reports the duration of commercial job versus change in pre-layoff salary. As stated earlier, the duration is computed as of November 30, 1965. From Table 69 it can be concluded that respondents who received

TABLE 68

NATURE AND LOCATION OF COMMERCIAL JOBS

Nature of Commercial Work N = 408		Location of Commercial Job N = 432	
1. Design	27.6%	1. San Francisco Bay Area	75.6%
2. Plant engineering	17.6	2. California (outside S.F.B.A.)	7.4
3. Development	14.4	3. Pacific & Mountain West	5.1
4. Production	12.1	4. S. Atlantic; E. S. Central; W. S. Central	5.4
5. Sales engineering	11.8	5. West N. Central and East N. Central	3.0
6. Research	6.2	6. Mid Atlantic and New England	3.5
7. Non-engineering jobs	10.3	7. Others	0.0
TOTAL	100.0	TOTAL	100.0

TABLE 69

DURATION OF COMMERCIAL JOB VERSUS CHANGE IN PRE-LAYOFF SALARY

N = 378

Salary Change Duration	Increase N = 103	No change N = 152	Decrease N = 123
Less than 6 months	7.8%	13.1%	32.6%
7-12 months	20.3	29.6	35.7
13-18 months	48.6	44.2	24.4
More than 18 months	23.3	13.1	7.3
TOTAL	100.0	100.0	100.0

salary increases at their post-layoff commercial jobs had a longer duration than those who received cuts or no change in their salaries. Additional study of the data shows that younger respondents had been at their commercial jobs for a longer period of time than older respondents. When data concerning salary changes are analyzed with respect to age, it is found that a larger proportion of the younger respondents received increases or no changes in their salary than the older subjects. The period of unemployment has no influence on the duration of the commercial job.

9.4 Comparison of Personal Characteristics: Transferred Versus Not-transferred Respondents

This section deals with the personal characteristics of those who transferred to commercial work as compared to those who remained in defense work. Examination of the data reveals that respondents who shifted to commercial work possessed lower educational background, were younger, and had lower pre-layoff salaries than those who did not shift. Furthermore, the shifted group read fewer technical magazines, took fewer courses at their place of employment, and were members of fewer professional societies when compared with the not-shifted group.

Tables 70, 71, and 72 give comparative educational background, age distribution and pre-layoff salaries for those who shifted to commercial work and for those who did not do so. An examination of Table 70 illustrates that as the educational level goes down, the proportion of those who shifted to commercial work goes up. A contrary trend exists in the case of those who did not shift to commercial work.

TABLE 70

EDUCATIONAL BACKGROUND FOR THOSE WHO SHIFTED TO COMMERCIAL WORK AND FOR THOSE WHO DID NOT SHIFT
N = 876

Education	Shifted to Commercial work	Did not Shift	Total
Doctor's Degree N = 19	26.3%	73.7	100.0
M.S. Degree N = 100	46.0%	54.0	100.0
B.S. Degree N = 512	49.6%	50.4	100.0
Non-Degree N = 245	54.5%	45.5	100.0

Table 71 shows that as age decreases, the percentage of those who transferred to commercial work increases. However, for those who did not transfer to commercial work, an opposite trend is evident. It can, therefore, be stated that relatively younger respondents shifted to commercial work.

TABLE 71

AGE DISTRIBUTION FOR THOSE WHO SHIFTED TO COMMERCIAL WORK AND FOR THOSE WHO DID NOT SHIFT

N = 859

Age	Shifted Commercial Work	Did Not Shift	Total
56 years and above N = 81	40.6%	59.4	100.0
46-55 years N = 171	45.0%	55.0	100.0
36-45 years N = 327	51.6%	48.4	100.0
35 years and less N = 280	52.1%	47.9	100.0

A perusal of Table 72 reveals that a relatively higher proportion of those in the lower salary brackets transferred to commercial work. The percentage of respondents who shifted to commercial work increases as the salary level declines. This is not the case with those who stayed in defense work.

TABLE 72

PRE-LAYOFF SALARY FOR THOSE WHO SHIFTED TO COMMERCIAL WORK AND FOR THOSE WHO DID NOT SHIFT

N = 874

Yearly Salary	Shifted to Commercial Work	Did Not Shift	Total
$15,000 and above N = 56	33.9%	66.1	100.0
$12,000-14,999 N = 177	40.7%	59.3	100.0
$10,000-11,999 N = 262	49.2%	50.8	100.0
less than $10,000 N = 379	56.2%	43.8	100.0

Tables 73, 74, and 75 show that as membership in professional societies goes up; as the number of courses completed at place of employment increases; and as the number of technical magazines read grows larger; the proportion of defense engineers and scientists who shifted to commercial work grows smaller. A contrary trend is evident for those who did not shift.

TABLE 73

NUMBER OF TECHNICAL MAGAZINES READ FOR THOSE WHO SHIFTED TO COMMERCIAL WORK AND FOR THOSE WHO DID NOT SHIFT
N = 855

Number of Magazines	Shifted to Commercial work	Did Not Shift	Total
5 or more N = 235	44.6%	55.4	100.0
3 - 4 N = 297	48.7%	51.3	100.0
1 - 2 N = 235	54.5%	45.5	100.0
None N = 88	54.5%	45.5	100.0

TABLE 74

MEMBERSHIP IN PROFESSIONAL SOCIETIES FOR THOSE WHO SHIFTED TO COMMERCIAL WORK AND FOR THOSE WHO DID NOT SHIFT
N = 866

Number of Societies	Shifted to Commercial Work	Did Not Shift	Total
Three or more N = 57	35.1%	64.9	100.0
Two N = 100	42.0%	58.0	100.0
One N = 239	44.8%	55.2	100.0
None N = 470	56.0%	44.0	100.0

TABLE 75

NUMBER OF COURSES COMPLETED AT PLACE OF EMPLOYMENT FOR THOSE WHO SHIFTED TO COMMERCIAL WORK AND FOR THOSE WHO DID NOT SHIFT
N = 794

Number of Courses	Shifted to Commercial Work	Did Not Shift	Total
9 or more N = 89	42.7%	57.3	100.0
5 - 8 N = 133	47.4%	52.6	100.0
1 - 4 N = 387	48.4%	51.6	100.0
None N = 185	58.9%	41.1	100.0

Although engineers and scientists who shifted to commercial work read comparatively fewer magazines, completed smaller number of courses at their place of employment, and were members of fewer professional societies; they have a larger number of patents to their credit. Table 76 gives the number of patents issued to those who shifted to commercial work and to those who did not do so. From Table 76 it can be observed that as the number of patents issued declines, the proportion of those who shifted to commercial work also declines. In the case of those who did not shift, an opposite trend is evident. It appears that commercial employers value patents more than technical magazine readership, membership in professional societies, or completion of courses at place of employment.

TABLE 76

NUMBER OF PATENTS ISSUED FOR THOSE WHO SHIFTED TO COMMERCIAL WORK AND FOR THOSE WHO DID NOT SHIFT
N = 840

Number of Patents	Shifted to Commercial Work	Did Not Shift	Total
3 or more N = 48	57.2%	42.8	100.0
1 - 2 N = 71	55.1%	44.9	100.0
None N = 751	48.9%	51.1	100.0

As far as areas of specialization are concerned, engineers and scientists with different specializations shifted to commercial work in accordance with their proportion in the total population. The number of job applications submitted by those who shifted to commercial work does not differ significantly from the number for those who did not shift.

Table 77 presents the period of unemployment for the shifted and the not-shifted groups. It appears that as the period of unemployment increased, proportionately more and more defense engineers shifted to commercial work. The discrepancy in the 25 weeks and above category is because of the fact that after 24 weeks, a larger number (26 percent) of the not-shifted group were still unemployed as compared to only 18 percent of the shifted group.

Additional analysis of the data shows that a larger number of engineers and scientists who shifted to commercial work obtained jobs within the State of California. For instance, 26 percent of the not-shifted group had to leave California in order to obtain their post-layoff jobs. The comparative figure for the shifted group is only 17 percent.

TABLE 77

PERIOD OF UNEMPLOYMENT FOR THOSE WHO SHIFTED TO COMMERCIAL WORK AND FOR THOSE WHO DID NOT

N = 694

Period of Unemployment	Shifted to Commercial Work	Did Not Shift	Total
Less than 4 weeks N = 151	47.6%	52.4	100.0
5 - 10 weeks N = 180	51.1%	48.9	100.0
11 - 17 weeks N = 144	52.1%	47.9	100.0
18 - 24 weeks N = 66	60.6%	39.4	100.0
25 weeks or more N = 153	42.5%	57.5	100.0

TABLE 78

POST-LAYOFF SALARY FOR THOSE WHO SHIFTED TO COMMERCIAL WORK AND FOR THOSE WHO DID NOT SHIFT

N = 785

Yearly Salary	Shifted to Commercial Work	Did Not Shift	Total
$15,000 and above N = 56	39.3%	60.7	100.0
$12,000 - 14,999 N = 154	41.6%	58.4	100.0
$10,000 - 11,999 N = 203	49.3%	50.7	100.0
$8,000 - 9,999 N = 211	55.0%	45.0	100.0
Less than $8,000 N = 161	71.4%	28.6	100.0

The post-layoff salaries for the shifted and the not-shifted groups are reported in Table 78. From Table 78 it can be seen that engineers and scientists who shifted to commercial work received lower salaries than those who did not shift. But as pointed out earlier (Table 72) the pre-layoff salaries of the shifted group were also lower.

9.5 Summary

Shifts from defense to commercial work are a common phenomena among defense engineers. An analysis of the 5-year job history of the 876 respondents shows that 37.5 percent of the total number of job changes involved shifts from defense to commercial work. An examination of the post-layoff job changes reveals that 53.8 percent of the respondents transferred to commercial work. As of November 30, 1965, the median duration of commercial jobs was 13.5 months. The data indicate that subjects who either received increases or no change in their salaries at the commercial job had a longer tenure than those who received cuts in their salaries.

A comparison of the personal characteristics of those who shifted to commercial work and of those who remained in defense work shows that the shifted group possesses lower educational background, is younger, and has lower pre-layoff salaries than the non-shifted group. Furthermore, the respondents in the transferred group read fewer technical magazines, take fewer courses at work, and are members of fewer professional societies than respondents in the not-transferred group.

CHAPTER X

SUMMARY OF FINDINGS

The analysis presented in this report has brought to the forefront many facts which, heretofore, either were not known or had remained unsubstantiated. The following is a list of the major findings.

10.1 Transfers from Defense to Commercial Work

Shifts from defense to commercial work are quite common among engineers and scientists. On the average, 38 percent of those who change jobs transfer to commercial work (Section 9.2). Subsequent to the most recent layoffs, 54 percent of the respondents shifted to commercial work. The median duration of commercial jobs, as of November 30, 1965, was 13.5 months. Engineers and scientists who transferred to commercial jobs were working on assignments involving industrial gear design, medical electronics, industrial process control, automotive engineering, etc. Respondents who received salary increases had been on their commercial jobs for a longer period of time than those who received salary cuts (Section 9.3).

A comparison of the personal characteristics shows that engineers and scientists who transferred to commercial work are relatively less educated, younger, and receive lower pre-layoff salaries than those who did not transfer. Moreover, the transferred group read fewer technical magazines, take fewer courses offered at work, and are members of fewer professional societies than the not-transferred group (Section 9.4).

10.2 Age and Re-employment

The hiring policies of employers appear to be discriminating towards older engineers and scientists. Irrespective of their educational background, pre-layoff salary, technical publications, patents, readership in technical magazines, and membership in professional societies, older engineers and scientists remained unemployed for a much longer period of time, (Section 5.2). Moreover, the influence of age on the period of unemployment increases as the educational level of the respondents goes down.

For respondents with different educational background, step-wise regression analyses were carried out with period of unemployment as the dependent variable and age, industrial experience, and salary as independent variables. The results show that regression coefficients for age for the non-degree, B.S. degree holders, and M.S. degree holders are .497, .138, .042, respectively. The first two coefficients are significant at the .01 level. In the case of M.S. degree holders, the highest regression coefficient (-.607) is obtained for salary. This coefficient is significant at the .01 level (Section 5.2). It appears that obtaining an advanced degree is one of the ways of counteracting the dysfunctional effects of old age.

10.3 Duration of Unemployment

Subsequent to their layoff, engineers and scientists remain unemployed for a considerably long period of time. For the San Francisco Bay Area, the median period of unemployment for laid off engineers and scientists is 12 weeks (Section 5.1). Approximately one-third remained unemployed for 18 weeks or longer, and 6 percent were without a job for more than one year.

The period of unemployment is independent of educational background, publications, patents, readership of technical magazines, courses taken at place of work, adult education and/or workship courses completed in engineering or science, and membership in professional societies (Section 5.1).

10.4 Company Layoff Policies

10.4.1 Layoff Criteria

Defense-oriented firms in the San Francisco Bay Area appear to have laid off engineers and scientists primarily on the basis of their age. For example, 33 percent of the laid off engineers and scientists are 45 years of age or older. In view of the estimate that 17 percent of the industry's engineers and scientists are 45 years of age and above, proportionately twice as many engineers and scientists who are in the 45 years plus category were laid off (Section 3.3). When educational background, technical publications, patents, membership in professional societies, and number of engineering and scientific courses completed at work are considered, there is no statistically significant difference between laid off and working engineers and scientists (Sections 3.1, 3.2, 3.4, 3.5).

10.4.2 Length of Advance Notice

The defense employers do not give a reasonable advance notice of pending layoffs to engineers and scientists. One-half of the engineers and scientists who were laid off by 62 defense companies in the San Francisco Bay Area received advance notices of 7.58 working days or less. Fourteen percent did not receive any advance notice whatsoever of their forthcoming layoff (Section 4.2.1).

Seniority of the respondents had no influence on their time of layoff. Subjects who had been with their employers for five years or longer were laid off at approximately the same rate as those who had been with their firms for two years or less.

10.5 Job Search Methods

Sending direct applications to companies is the most efficient method of obtaining engineering and scientific jobs. Friends and personal contacts and newspaper advertisements are the second and the third most efficient methods of seeking re-employment (Section 6.3).

Out placement services offered by employers is not a commonly used method. However, it is the fourth most efficient method of obtaining jobs. Private employment agencies, State of California Department of Employment, services of professional societies, and trade and professional magazines are less efficient than the out-placement services of the employers (Section 6.3).

A large majority (61 percent) of the unemployed engineers and scientists normally visit the State of California, Department of Employment for the purpose of seeking jobs. However, only a few of these individuals are successful in obtaining jobs by this method. (Section 6.3).

10.6 Sources of Financial Assistance

Unemployment insurance is the most commonly used and the most important source of financial support for unemployed engineers and scientists (Table 33). Approximately 74 percent of those who remained unemployed used this source of financial assistance. Even though unemployment insurance is the most commonly used, and the most important source of financial support, it is not an adequate source. For instance, 51.4 percent of the engineers and scientists who remained unemployed for four weeks or less, had to liquidate their savings and investments (Table 35).

The fact that an individual receives unemployment insurance does not make his job search activities inferior. On the contrary, engineers and scientists who used unemployment insurance were more active in their job search efforts than those who did not use unemployment insurance (Section 6.2).

10.7 Non-degree Respondents

Attending college and/or a university and completing pertinent courses is the most commonly used method (46%) by non-degree engineers and scientists for achieving technical competence. Self-motivated reading and on-the-job practical experience are the second and the third most important means of achieving engineering and scientific competence (Section 3.6).

10.8 Geographical Mobility

Massive defense layoffs normally result in sizeable out-migration of engineers and scientists from the general area. For instance, subsequent to their recent layoffs, 38 percent of the laid off engineers and scientists left the San Francisco Bay Area, and 21 percent left the State of California.

The engineers and scientists who left California were younger, had obtained higher levels of education, and had received their formal degrees more recently than those who did not leave the state (Section 7.2).

Since the 1964 layoffs, the in-migration of scientists and engineers to California has slowed down and the out-migration has accelerated (Section 8.4).

10.9 Salary and Job Changes

The most common reason for which engineers and scientists change jobs is higher salary. More interesting work and layoffs are reported to be the second most frequent and the third most frequent reasons for job changes (Section 8.2). In general, 45 percent of those who change jobs receive salary increases. Under poor business conditions this proportion drops to 21 percent. The proportion of those receiving salary cuts varies from a low of 10 percent, under good business conditions, to a high of 28 percent, under poor business conditions (Section 8.3).

CHAPTER XI

OBSERVATIONS AND RECOMMENDATIONS

The findings presented in Chapter X are based on the analysis of the 876 questionnaires completed by engineers and scientists who were laid off by 62 defense companies located in the San Francisco Bay Area. In addition to the computations reported in this study, the author has analyzed the detailed comments submitted by these respondents on several open-ended questions. He has also conducted personal interviews with 150 laid off engineers and scientists.

Furthermore, the author has interviewed personnel managers and key executives of 53 of the 62 defense firms involved. This constitutes interviews with the management of 86 percent of the defense companies which had engineering and scientific layoffs. Moreover, he has interviewed personnel managers and key executives of 22 commercial firms.

11.1 Observations on Causes of Defense Layoffs

On the basis of the above mentioned interview efforts, as well as the data collected by the 876 questionnaires, the author has compiled the following list of reasons for the instability of defense-oriented engineering and scientific employment.

1. One of the main reasons for engineering layoffs is the periodic cutbacks and shifts in defense spending. It was reported by many interviewees that some of the major shifts in defense spending, to some extent, have been political. One individual commented:

> The government has no regard for the stability of engineers. Each political party and each president have their own idea as to which part of the country will get big government contracts. This causes hardships, unemployment, layoffs, and a constant movement of personnel.

When asked to provide evidence in support of this feeling, the interviewees presented copies of several daily newspapers giving news of layoffs in the San Francisco Bay Area in the first section and giving large advertisements for engineers and scientists in Alabama, Louisiana, and Texas in the want-ad section.

2. Personnel managers from several companies pointed out that, at times, the Department of Defense has cancelled large defense contracts involving thousands of workers at unreasonably short notice. It was maintained that the companies cannot absorb such large scale cancellations without mass layoffs unless the companies themselves receive a reasonable advance notice.

3. Poor manpower planning on the part of certain company managements is another reason which leads to engineering and scientific unemployment. Some interviewees felt that a company should not accept a large contract, if the manpower and the facilities available are inadequate. They cited examples of companies which accepted extensive contracts and then hired workers to the extent of establishing a growth rate of more than 100 percent. Such growth rates, in the opinion of some executives, are too excessive and lead to instability both for the company, the community in general, and the engineers and scientists involved.

It was pointed out that there are companies, both small and medium sized, in which the managements emphasize the "over-sold" position of their companies' manpower and facilities. In such cases, once the company's resources are committed for one year or longer on certain contracts, the management would not accept additional work. Furthermore, these companies hire professional engineers with great care and with a view of providing them with permanent employment. The growth rates for such companies are between 10 and 15 percent per year.

4. Some of the existing practices in the defense industries are important factors in creating engineering employment instability. As an illustration, consider project "P", with estimated cost of $900,000,000, for which the Department of Defense has asked bids from throughout the country. For the sake of argument, let us assume there are four companies named B, C, D, and E bidding for project "P".

As one of the company managers explained, in order to show to the contracting agency that the company has the manpower and the facilities available to do the job, company B hires 300 engineers and scientists, company C does likewise, and company D recruits 300 engineers and scientists to prove its capabilities to complete the project. Company E hires 300 engineers and, in addition, spends a million dollars on a new building to show its capabilities and interest in project "P".

In the end, only one of these four companies would be awarded the contract and the other three companies would not need the 300 engineers and scientists that each of them hired. When these four companies recruit these engineers and scientists, they do not inform the persons involved as to the possible temporary nature of the job. The individual describing this example stated that the solution for the 900 not-needed engineers and scientists is simple. He replied that the company receiving the contract would contact the personnel managers at the other three companies and would ask them to send their 900 recently hired engineers and scientists to them. Practices such as this do cause short-term instability in engineering employment and result in serious dislocation problems for individuals and their families.

The origin of the above-mentioned practice, it was reported, is in the fact that very often the Department of Defense requires that before a contract can be awarded, the company show that it has manpower and facilities already waiting to do the work. These requirements, in the opinion of some interviewees, are unreasonable, especially for large contract awards involving thousands of workers.

5. One of the reasons for the recent layoffs is the change in contracting policies of the Department of Defense--from cost-plus fixed fee contracts to cost-plus incentive type contracts. Whereas, under the old contracting policies, the company could earn at most 7 percent of the total sales; under the cost-plus incentive type contracts, the profits can go up to 14 percent of the net sales. Under the previous arrangements, therefore, it was beneficial for a company to have a large number of engineers work on a contract, because 7 percent of a larger payroll is better for the corporate earnings of the organization. Under the new system, the companies can earn higher profits if they do the work with the help of fewer but highly efficient engineers and scientists. This recent change in the contracting policies has forced defense companies to become more efficient and as a result many marginal and inefficient engineers and scientists were discharged.

6. Another important reason for engineering and scientific unemployment is the fact that technical talent is concentrated in a few geographical locations. Such locations are the Pacific Coast, the North East, and the South East regions. The problem arises because at any particular time either most of the companies in each of these regions are laying off engineers and scientists or they are doing intensive hiring simultaneously. Because of lack of diversification in these regions, there are no cushioning effects in the event defense cutbacks and/or shifts occur.

11.2 Observations on Manpower Policy

There are individuals who believe that layoffs are an essential part of the free enterprise system and that they can never be avoided. These individuals claim that business organizations cannot be efficiently run if management cannot resort to layoffs. The author agrees that there are times when because of poor business conditions layoffs are absolutely necessary. However, in the case of defense industries, layoffs have occurred during years of record profits for the companies involved. For example, in the case of one defense contractor, net earnings after taxes rose by more than 100 percent during the year the comapny had mass layoffs. Another defense employer had record earnings during the year it laid off large numbers of engineers and scientists.

An important feature of layoffs by defense firms is that they are periodic. Within six-months to a year after the previous layoff, defense companies usually have extensive recruitment programs. For instance, the most recent layoffs affected 30,000 engineers and scientists. It appears that within a one-year period more than 90 percent of these laid off individuals were able to locate jobs. If it is assumed that approximately 50 percent of them found re-employment with defense employers, it meant a net loss of $35 million to the Department of Defense. The loss is computed by adding the severence pay, recruitment expenses, and relocation allowances--all of which come out of the overhead charged to the Department of Defense.

11.3 Recommendations to the Agencies of the Federal Government

1. The Bureau of Employment Security, in conjunction with State Departments of Employment and through its Labor Inventory Communications System (LINCS), has at its disposal a network which can improve the job-information process for engineers and scientists seeking employment.

This study has shown that 60 percent of the laid off engineers and scientists submitted work applications at various offices of the California State Department of Employment. However, only 3 percent of these individuals obtained re-employment by this method. The main difficulty is that employers do not normally list professional job vacancies with these departments.

It is recommended that:

(a) The Bureau of Employment Security publish regional lists of engineers and scientists who are looking for jobs. These lists should be issued at regular intervals, say bi-monthly, and mailed to major employers in the region. A brief resume of the available engineers and scientists should be included in the list.

(b) The Department of Defense should require all contractors to list every job vacancy with the local State Departments of Employment.

(c) The Department of Defense should reduce the reimbursement to its contractors for job advertisements and for fees paid to private employment agencies. Such a step would encourage defense contractors to use the facilities of the Bureau of Employment Security.

2. This research has indicated that employers' hiring policies are discriminatory towards older engineers and scientists. If an individual is over 45 years of age, his technical capabilities--measured in terms of educational background, professional activities, and original contributions--are completely ignored. As pointed out in a recent publication of the U. S. Department of Labor, "if employment age restrictions persist, artificial manpower shortages will be created and a manpower squeeze will result. Even more important, America will be deprived of an invaluable resource, the experience and production sense of older workers."[57]

In order to assist the older engineers and scientists, the Department of Labor should:

(a) Institute special job-placement services for older workers.

(b) Provide retraining and updating facilities with special emphasis on obtaining advanced degrees.

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[57] U. S. Department of Labor, Ability is Ageless, Washington, D.C., U.S.G.P.O. (1960), p. 8.

3. The length of advance notices given to engineers and scientists were unreasonably short. Fourteen percent of the respondents did not receive any advance notice whatsoever of their forthcoming layoff; some of these respondents had worked for their company for five years or more. Fifty percent of the subjects received advance notice of 7.58 working days or less.

It is recommended that the Department of Labor sponsor national legislation establishing reasonable standards of advance notice based on an employee's length of service with the company.

4. As has been shown in this report, shifts from defense to commercial work are quite common among defense engineers and scientists. An average of one-third of the defense engineers who change jobs shift to commercial work.

Subsequent to their layoff, 54 percent of the defense engineers and scientists in the San Francisco Bay Area transferred to commercial work. These respondents made the shift apparently without any retraining. Evidence of large scale transference to commercial work was also noted by the Boston layoff study.[58]

The present study shows that respondents who received salary increases or no change in salaries at their commercial jobs had a longer tenure than those who received salary cuts. Furthermore, it was found that a higher proportion of respondents with lower pre-layoff salaries transferred to commercial work. It appears that if salary structures for commercial jobs are raised, even a larger number of defense engineers would shift to commercial work.

Thus, in planning for the impacts of disarmament and defense cutbacks, transferability of engineering and scientific skills does not appear to be a problem. The mutual transference between defense and commercial work would become even more widespread, if the commercial industries were to offer opportunities as attractive as the defense industries. This would be possible only when extensive R & D programs are established in the commercial industries.

The Arms Control and Disarmament Agency should sponsor legislation which will encourage commercial R & D spending and would raise the level of engineering and scientific opportunities offered by commercial companies.

5. If it is true that the Department of Defense has, in the past, cancelled large contracts without giving a reasonably long advance notice to the companies, then the Federal Government itself is a party to creating mass unemployment among engineers and scientists.

It is recommended that, in order to help stabilize engineering and scientific employment, the Department of Defense take another look at its policy of short-notice cancellations and try to avoid such actions in the future.

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[58] Mooney, *op. cit.*, p. 137.

11.4 Recommendations to Agencies of the State Government

1. This research has revealed that unemployment insurance is the most commonly used and the most important source of financial assistance to unemployed engineers and scientists. However, this source does not provide adequate financial support.

It is suggested that the unemployment insurance benefits be increased to the extent that the individual can obtain approximately one-half of his pre-layoff salary.

2. As has been pointed out earlier, 21 percent of the laid off engineers and scientists left California. Furthermore, the respondents who left California were younger, had obtained higher levels of education, and had received their formal degree more recently.

It is estimated that, as a result of recent layoffs, 250 engineers and scientists left the State of California. This out-migration has meant a net business loss of approximately 10 million dollars to the State. This means that the State has lost all of the income tax on this sum. Moreover, because of the multiplier effects, losses to real estate and other businesses have been enormous. A constructive action to counteract this out-flow of highly trained talent, therefore, is in the financial interest of the State of California.

The author urges that an Agency for the Conservation of Engineering and Scientific Resources (ACER) be established. This agency could either be a State financed semi-autonomous organization or it could be a non-profit organization funded by the State and private foundations.

As soon as a qualified engineer or scientist is laid off, he should be free to join the proposed agency and receive 50 percent of his pre-layoff salary for putting in a 40-hour work-week. The individual would be given every fourth week off to look for a job. During the work-weeks, he would be engaged in solving problems such as smog control, mass transportation, waste management, etc., etc. Seventeen percent of his salary would be paid by the company from which he was laid off, another 17 percent by the Department of Defense, and the remaining 16 percent by the State.

The engineers and scientists would be permitted to work in the proposed agency until they obtain full-time jobs. Since the engineers and scientists would be receiving only one-half of their regular salaries, and because they would be free every fourth week for their job-search activities, this would encourage them to locate a job as soon as possible. It is estimated that the proposed agency would not cost the State of California more than $3 million per year. Furthermore, the State would not be paying unemployment insurance to these engineers and scientists who elected to join ACER.

In addition to conserving engineering and scientific resources, and being in the financial interests of the State, the proposed agency would have several advantages.

(a) Because the companies would be required to pay 17 percent of the engineers' salary as long as he remains unemployed, the management will be more careful in laying off such individuals.

(b) The employers in need of engineers and scientists would know where the available men are. The personnel managers of such companies could be invited to the proposed agency for the purpose of interviewing the available engineers and scientists.

(c) Many of the State's technical problems would be solved at less than one-sixth of the cost.

11.5 Recommendations to Defense-Oriented Companies

1. The out-placement services arranged by some employers were the fourth most efficient method by which laid off engineers and scientists located jobs. However, only 25 percent of the respondents were provided such services. This means that a large majority of the defense firms did not make any arrangements to help their employees locate other jobs.

It is recommended that in the event of future layoffs, defense firms should provide out-placement services. These services could be either in the form of inviting other prospective employers to the plant and arranging interviews with individuals scheduled to be laid off, or in the form of mailing brief resumes of the individuals involved to other companies.

2. The study has shown that the respondents were not given a reasonably long advance notice of their forthcoming layoffs. One-half of the individuals involved received advance notices of 7.58 working days or less; 14 percent did not receive any advance notice.

A reasonably long advance notice would ameliorate the hardships caused by massive layoffs and would facilitate the re-employment process. It is urged that engineers and scientists, who have worked for their employer six months or longer, be given at least a four-week advance notice of their involuntary terminations.

3. Severence pay was the second most important source of financial assistance for the unemployed engineers and scientists. However, severence pay coupled with unemployment insurance was not an adequate source of financial support. Even the respondents who remained unemployed for four weeks or less had to depend upon liquidation of their savings and investments. Furthermore, only 54.6 percent of the subjects were given severence pay. During the personal interviews with engineers and scientists, it was pointed out that one large employer later unsuccessfully tried, by a suit, to get back the severence pay from the employees who were laid off.

In order to alleviate individual financial problems caused by layoffs, it is recommended that employers institute liberal severence pay policies.

4. The results of this research make it evident that the hiring policies of the employers are discriminatory towards older engineers and scientists. Apparently the employers disregarded educational background and other technical capabilities of older individuals. Some of these older engineers and scientists are undoubtedly above-average individuals and could contribute a great deal to the activities of defense employers.

It is advocated that the firms not discriminate against older workers and utilize this reservoir of experienced and well educated technical manpower.

5. Approximately 60 percent of the laid off engineers and scientists reported that their technical talents had not been utilized to the fullest extent. The more competent and the highly educated respondents reported relatively more under-utilization. Such large scale under-utilization is not only a waste of highly trained manpower, it is not in the best interests of the firms involved. Under the cost-plus-incentive type contracts, a reduction in under-utilization of technical talent would mean higher profits for the companies.

It is proposed that the defense firms institute appropriate programs for the purpose of avoiding under-utilization of technical manpower. An example of such a program would be to periodically request engineers and scientists to complete anonymous questionnaires designed to detect under-utilization and its causes. If it is determined that the firm's engineers and scientists feel under-utilized, then corrective steps based on the reported causes could be taken.

6. Some of the personnel managers and executives maintained that an excessive rate of growth on the part of some companies is another reason for engineering and scientific employment instability. It was pointed out that a growth of between 10 to 15 percent is a healthy one.

It is, therefore, recommended that the managements of defense companies plan reasonable growth rates compatible with long range stability of employment for its employees.

7. As was mentioned in Section 11.1, during the process of bidding for contracts, it appears that defense companies sometimes hire engineers and scientists on a temporary basis. However, the engineers and scientists involved are normally not told that, in the event the company is not awarded the contract, their jobs will be terminated. Furthermore, if the contract in question is a large one, numerous engineers and scientists are affected.

It was remarked by many interviewees that companies should be honest and frank with engineers and scientists. The individuals should be told in advance that the continuation of their jobs depends upon the award of a particular contract. It was observed that if the engineers and scientists knew their jobs depended upon the acceptance of a particular company proposal, these individuals would put a special effort into preparing the proposal. Moreover, in the event the company is not awarded the contract, individuals would not be faced with an emotional shock at an early termination.

It is recommended that in case of temporary appointments, defense companies should be candid with engineers and scientists and should inform them of the uncertain nature of the job.

8. The report has revealed that the four most commonly used methods by engineers and scientists for the purpose of locating jobs are:

(a) Direct applications to companies

(b) Newspaper advertisements

(c) Friends and personal contacts

(d) State Department of Employment

Of the four methods above, companies have used the State Departments of Employment the least. This study shows that 61 percent of the respondents visited various offices of the California State Department of Employment.

It is urged that the defense companies list all engineering and scientific vacancies with the State Departments of Employment.

11.6 Recommendations to Commercial Companies

1. From this study, it can be concluded that shifts from defense to commercial work are quite common among defense engineers and scientists. Apparently the engineers and scientists who transferred to commercial work have done so without any prior retraining. It appears, therefore, that alleged shortcomings of defense engineers and scientists, such as inability to work in jobs requiring broad technical background, lack of cost consciousness, etc., are unfounded.

It is suggested that commercial companies not discriminate against defense engineers and scientists.

2. In analyzing the shifts from defense to commercial work, it was found that commercial companies hired respondents who are relatively less educated, read fewer technical magazines, and take fewer courses at their place of employment. This was because commercial firms were able to attract lower-salaried respondents only. Such a trend will in the long run hurt the efficiency, the growth rate, the innovativeness, and hence the competitiveness of commercial industries.

This trend could probably be reversed if commercial companies would offer more attractive salaries and more challenging work. One of the ways to create more challenging jobs in the commercial firms is to increase the commercial R & D spending. It is thus urged that commercial firms:

(a) raise the level of their engineering and scientific salary structures, and

(b) expand their R & D programs

3. Just as the defense firms have avoided hiring older engineers and scientists, commercial companies have done likewise. A large reservoir of the nation's technically trained and experienced manpower is consequently being wasted.

It is recommended that commercial firms not reject well educated, competent engineers and scientists simply because of old age.

11.7 Recommendations to Engineers and Scientists

1. One of the ways in which engineers and scientists can help stabilize the employment market is by using discretion in selecting their future employers. They should avoid firms which have had periodic mass layoffs. It was reported to the author by many interviewees that, as a result of the recent layoffs, many engineers and scientists are now accepting job offers not on the basis of salary alone. They are presently taking into account the growth pattern and the past record of employment stability of the firm. One of the national magazines commented on the situation as follows:

> Probably the one bright spot in this picture is that many engineers are examining these tantalizing offers carefully, and then rejecting them. There is not the mobility there once was. Too many engineers remember the layoffs of 24 months ago. Out on the West Coast, personnel managers complained that many eastern engineers won't even listen to their blandishments because of the reputation the industry out there has earned for severe ups and downs.[59]

It is urged that engineers and scientists, before accepting employment, examine the past record of the company in terms of employment stability.

2. The results of this study show that engineers and scientists who became victims of recent layoffs were given unreasonably short advance notice. One out of every seven of the respondents did not receive any advance notice. One-half of them received advance notice of 7.58 working days or less. Furthermore, 45 percent of the respondents did not receive any severence pay.

In order to alleviate hardships caused by sudden and massive layoffs, engineers and scientists should ask for guarantee of a reasonably long advance notice (a minimum of four-weeks advance notice after six-months service) or four weeks severence pay in lieu of advance notice.

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[59] "Help Wanted Maybe," editorial, Electronics (March 1966), p. 23.

Such requests could be made to the companies through engineering professional societies or by individual engineers and scientists at the time of their employment.

A few of the engineering societies have taken positive actions toward finding solutions to the problem of periodic engineering unemployment. For instance, the National Society of Professional Engineers has shown its concern for this problem. The State of California Chapter of this society arranged a two-day symposium entitled "Engineering Employment--Can We Meet the Challenge?" and came up with several recommendations. Engineers and scientists should support professional societies which look after their economic interests.

3. The three most important methods of job search, according to this report, are:

(a) Direct applications to companies

(b) Friends and personal contacts

(c) Newspaper advertisements

While looking for a job, engineers and scientists are urged to concentrate on the three above-mentioned methods.

11.8 Recommendations for Further Research

On the basis of experience gathered from conducting this study, the author would like to recommend that further research be conducted in the following areas.

1. Diversification of defense industries has been suggested for a considerable number of years as one of the solutions for overcoming the effects of periodic defense cutbacks and shifts in defense spending. It has been proposed that all firms doing business with the Federal Government be required to keep their net defense sales below a certain designated percentage of their total sales. A figure of 50 percent defense and 50 percent commercial sales has been advocated by some observers.

According to a recent study of the impacts of defense cutbacks on electronics industries, conducted by the Battelle Memorial Institute of Columbus, Ohio, many diversification attempts among larger companies have been less than vigorous. Aggressive diversification efforts among some medium-sized companies ($2 million-$100 million net sales) have been highly successful over a three-to-five year period.[60]

The findings of the study show that as far as defense engineers and scientists are concerned, shifts from defense to commercial work have been quite common. Apparently, transferability of skill and experience of defense engineers and scientists is not an obstacle towards diversification of defense-oriented firms. During the interviews, it was pointed out to the author, that some of the defense companies do not wish to specialize in anything but defense work, because the chief executives of these companies are either mostly aircraft and missile designers or they are retired military officers, or both. It was indicated that these individuals are not capable of leading their companies successfully into commercial markets.

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[60] Peck, op. cit., p. 40.

It is thus proposed that a study of the problems faced by executives of defense companies in shifting their firms successfully into commercial markets be conducted.

2. Under the sponsorship of the Department of Defense, the Department of Labor, and the Arms Control and Disarmament Agency, several studies dealing with defense-oriented layoffs have been conducted. However, as has been shown in this study, defense layoffs normally result in subsequent commercial layoffs.

It is urged that a study dealing with the unemployment and re-employment experiences of engineers and scientists laid off by non-defense companies be conducted. A comparison of such a study with the already completed defense layoff studies could lead to some very useful results.

11.9 Assessment of the Research Methodology Used

1. On the basis of this study, it can be stated that with the help of mail questionnaires and follow-up reminders, above average response rates are achievable from samples of engineers and scientists. In this study, 96 percent of those engineers and scientists who were contacted co-operated. The respondents, however, were quite sensitive to the contents of the questionnaire and the cover letter.

2. One disadvantage of the mail questionnaire is that certain issues cannot be dealt with in depth. Personal interviews with a sub-sample of the respondents should avoid this deficiency in the methodology.

In the case of this study, no personal interviews with laid off engineers and scientists other than for the pretest of the questionnaire were planned. However, because of the author's contacts with the Technical Placement Co-op, many engineers visited him personally. Through this and various other means, he was able to conduct a total of 150 personal interviews with respondents.

3. During the analysis of the data, it was felt that the design should have included a control group of working engineers and scientists from the defense industries of the San Francisco Bay Area. Data from such a control group would have facilitated comparative analysis in depth of items such as personal characteristics, job history, occupational conversion, and technical capabilities.

4. In most of the questions where multiple answers were possible, the respondents were instructed to rank order the three most pertinent answers. However, in the case of two questions, this instruction was not included. This appears to have been an unwise decision. The author feels that in all questions where multiple answers are possible, the respondents should be advised to rank order not more than the three most important answers.

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APPENDIX A

COVER LETTER AND QUESTIONNAIRE WHICH WAS MAILED TO SUBJECTS

A.1 Cover letter to engineers and scientists

A.2 Questionnaire

SAN JOSE STATE COLLEGE
SAN JOSE, CALIFORNIA

ENGINEERING MANPOWER RESEARCH PROJECT

15 November 1965

Dear Sir:

As you are probably aware, San Jose State College has been, for some time, concerned with the problem of unemployment and subsequent re-employment of San Francisco Bay Area's engineers and scientists. On 16 May 1964 the program "Careers in Crisis" was launched at the college campus and this led to other efforts, such as the "Technical Placement Co-op", to assist the then unemployed professionals.

After talking to more than 150 then unemployed engineers and scientists, we recognized the need for organized data concerning the difficulties all such persons were facing both in terms of maintaining their family expenses and of locating new jobs. On 15 April 1965, the San Jose State College Administration entered into a signed agreement with the Office of Manpower, Automation, and Training of the U.S. Department of Labor to study the unemployment and re-employment experiences of engineers and scientists who were separated from aerospace, electronics, and other companies in the San Francisco Bay Area during 1964.

Through the enclosed questionnaire we intend to explore some of the problems which may have been encountered in finding re-employment. The ultimate aim of this study is to point out needed public or private programs to assist engineers and scientists who may become unemployed in the future.

Your name and address were obtained either from your previous employer, or from the files of the Technical Placement Co-op, or from your friends. However, in a few cases, your former employer mailed the questionnaire directly to you for completion. I would like to assure you that your name and all information which you provide to us will be kept in strict confidence and will not be released to anyone except individuals working on this project.

In order that we may publish the final results of the study according to schedule, we shall appreciate your completing the enclosed questionnaire and returning it to us in the enclosed self-addressed stamped envelope within a week, if possible.

We hope that you will participate in this important study involving one of the nation's most critical manpower resources. The results could have significant meaning for yourself and other engineers and scientists, in the San Francisco Bay Area, and in the entire nation. Your participation in the study is of course, voluntary -- but yet essential to its successful completion.

Sincere thanks for your cooperation.

Respectfully yours,

R.P. Loomba
R. P. Loomba, Director

RPL/mh

B.O.B. No. 44-6545
Expiration Date 12-31-66
DL/MT -- 232 A

SAN JOSE STATE COLLEGE
SAN JOSE, CALIFORNIA

ENGINEERING MANPOWER RESEARCH PROJECT

INSTRUCTIONS

1. Please answer these questions in as much detail as you can. If the space provided for answers is not sufficient, use an extra sheet of paper and mail it with the questionnaire.
2. Answer the questions in the order they are presented.
3. Disregard the numbers alongside the spaces to be checked. They are for use in processing the answers.
4. Please complete this questionnaire and return it in the enclosed self-addressed stamped envelope within one week. This will help us complete the study according to schedule.

SECTION A

EDUCATIONAL BACKGROUND

1. How many years have you been working as an engineer or a scientist full time?

7-0 ____ more than 30 years
1 ____ between 25 and 30 years
2 ____ 20-24
3 ____ 15-19
4 ____ 10-14
5 ____ 8-9
6 ____ 6-7
7 ____ 4-5
8 ____ 2-3
9 ____ less than 2 years

2a. After receiving your last formal degree, have you had other full-time job(s) than as an engineer or a scientist?

8-0 ____ no
1 ____ yes

IF NO, PLEASE SKIP TO QUESTION NO. 3.

2b. IF YES, what were they? Please list them below.

9- ____
____
____
____

2c. How many years in total did you work on these non-scientific jobs?

10-0 ____ less than 1 year
1 ____ between 1 and 2 years
2 ____ 2-3
3 ____ 4-5
4 ____ 6-7
5 ____ 8-9
6 ____ 10-11
7 ____ 12-13
8 ____ 14-15
9 ____ more than 15 years

3a. Was your first full-time job, after completion of formal education, other than as an engineer or a scientist?

11-0 ____ no
1 ____ yes

3b. IF YES, what was it? Please specify:

12- ____

4. What were your reasons for choosing an engineering or a scientific career? Number (1, 2, 3) the three most important reasons in the order of preference. Number 1 being the most important, number 2 the next important and so on.

DO NOT CHECK MORE THAN THREE.

13, 14,
15-0 ____ job security
1 ____ opportunity for personal advancement
2 ____ interesting work
3 ____ high prestige of the profession
4 ____ many available jobs
5 ____ friends and relatives in the profession
6 ____ others, please specify: ____________
____

5. Did one or more of the following influence your choice of the engineering or scientific career? Please check in the space at the left which persons influenced your decision.

→ Were any of the persons who influenced you engineers or scientist? Check below.

	Yes	No
____ father	16-0 ____	1 ____
____ immediate family other than your father	2 ____	3 ____
____ older friends or other relatives	4 ____	5 ____
____ friends of the same age	6 ____	7 ____
____ teacher(s)	8 ____	9 ____
____ guidance counselor(s)	17-0 ____	1 ____
____ others, please specify: ____________		
____ no one		

6. Please check the highest level of formal education completed by you.

18-0 ____ Doctor's degree
1 ____ Engineer's degree (based on at least one full year's work beyond Master's degree)
2 ____ some courses beyond Master's degree
3 ____ Master's degree
4 ____ some courses beyond Bachelor's degree
5 ____ Bachelor's degree
6 ____ some courses beyond high school, but not enough to receive a Bachelor's degree
7 ____ high school
8 ____ less than high school

7. For the highest level of education attained, please indicate your major field of specialization:

19-0 ____ Astronomy
1 ____ Chemistry
2 ____ Mathematics
3 ____ Physics
4 ____ Aeronautical Engineering
5 ____ Chemical Engineering
6 ____ Civil Engineering
7 ____ Sanitary Engineering
8 ____ Electrical Engineering
9 ____ Industrial Engineering
20-0 ____ Mechanical Engineering
1 ____ Mining Engineering
2 ____ Metallurgical Engineering and Metallurgy
3 ____ Geology
4 ____ Geophysics
5 ____ Meteorology
6 ____ others, please specify: ____________

8a. When did you receive your highest degree or diploma?

21-0 ____ before 1920
1 ____ between 1920-1925
2 ____ 1926-1930
3 ____ 1931-1935
4 ____ 1936-1940
5 ____ 1941-1945
6 ____ 1946-1950
7 ____ 1951-1955
8 ____ 1956-1960
9 ____ after 1960

8b. From which institution did you receive your highest degree or diploma?

22- ______________________________
(NAME OF THE INSTITUTION)

9a. If you did not possess a Bachelor's degree in 1964, how did you achieve your position as an engineer or a scientist? Check the most relevant item. DO NOT CHECK MORE THAN ONE.

23-0 ____ started as a technician and worked my way up
1 ____ started as an administrative assistant, shifted into technical areas and worked my way up
2 ____ started as a technical assistant and worked my way up.
3 ____ others, please specify: ____________

9b. If you did not possess a Bachelor's degree in 1964, how did you achieve competence in engineering or science? Check the two most relevant items:

24,25-0 ____ by reading books, magazines, and technical manuals on my own
1 ____ by attending college (university) and completing pertinent courses
2 ____ by attending technical institutes and/or trade schools
3 ____ by completing courses and workshops offered at my place of work
4 ____ by completing correspondence, extension, or adult education courses
5 ____ by practical experience on the job
6 ____ others, please specify: ____________

10. If you have completed any adult education (non-college), correspondence, or workshop courses in engineering or science after receiving your last degree or diploma, please check their number below.

26-0 ____ more than 10
1 ____ between 9 and 10
2 ____ 7-8
3 ____ 5-6
4 ____ 3-4
5 ____ 1-2
6 ____ none

11. Since receiving your last degree or diploma, if you have completed any courses offered at the places(s) of your employment, please indicate their number below.

27-0 ____ more than 10
1 ____ between 9 and 10
2 ____ 7-8
3 ____ 5-6
4 ____ 3-4
5 ____ 1-2
6 ____ none

SECTION B

POST TERMINATION EXPERIENCE DURING 1964-65

INSTRUCTIONS: THE QUESTIONS IN THIS SECTION CONCERN YOUR EMPLOYMENT, TERMINATION, AND SUBSEQUENT JOB SEARCH EXPERIENCES PRIMARILY DURING 1964 AND IN SOME CASES DURING 1965 ALSO.

1. During which month did you terminate your job in 1964? IF YOU TERMINATED MORE THAN ONCE DURING 1964, INDICATE THE MONTH NEAREST TO JANUARY 1964.

28-0 ____ January-February
1 ____ March-April
2 ____ May-June
3 ____ July-August
4 ____ September-October
5 ____ November-December

2a. Which company were you working for at the time of the above-mentioned termination?
29,30,31,32,33________________________
(NAME OF THE COMPANY)

2b. How many years did you work for the above company?

34-0 ____ more than 5 years
1 ____ between 4 and 5 years
2 ____ 2-3 years
3 ____ one year
4 ____ less than 1 year

2c. While at the above mentioned company, was your technical and scientific training utilized to the fullest extent?

35-0 ____ yes
1 ____ no

2d. IF NO TO 2c., please explain below: 36-______
____
____
____

3a. How would you classify the type of work that you were doing at the above named company?

37-0 ____ mostly aerospace
1 ____ mostly electronics
2 ____ others, please specify: ________________
____

3b. Was your work predominantly:

38-0 ___ defense-oriented (under government defense contract or subcontract)
1 ___ non-defense

3c. What was your approximate yearly salary at the time of your first (or only) termination in 1964?

39-0 ____ over $21,000
1 ____ between $18,000 and $21,000
2 ____ $15,000-$17,999
3 ____ $12,000-$14,999
4 ____ $10,000-$11,999
5 ____ $8,000-$9,999
6 ____ $6,000-$7,999
7 ____ less than $6,000

3d. At the time of your above termination, did you (check one):

40-0 ____ own home completely?
1 ____ own home partially with a mortgage?
2 ____ rent with lease?
3 ____ rent without lease?
4 ____ others, please specify:________________
____

4. What were your reasons for terminating the above-mentioned job in 1964?

Got a job elsewhere which offered:

41-0 ____ better geographical location
1 ____ higher salary
2 ____ better working conditions
3 ____ more interesting work
4 ____ job security
5 ____ opportunity for advancement
6 ____ shorter commuting distance

7 ____ Was laid off for lack of work
8 ____ Was dismissed
9 ____ Others, please specify:________________
____

5. If you did not terminate voluntarily, how much advance notice were you given by your employer?

42-0 ____ none
1 ____ up to 2 weeks
2 ____ between 3 and 4 weeks
3 ____ 5-6
4 ____ 7-8
5 ____more than 8 weeks

6a. Did the company give you any leave to look for a job?

43-0 ___ yes, with pay
1 ___ yes, without pay
2 ___ no

6b. Did the company offer you another job in the same or in a different geographical area?

44-0 ___ yes, in the same geographical area
1 ___ yes, in a different geographical area
2 ___ no, no job offered

6c. If YES to the above question, please check the appropriate items concerning the job offered.

45-0 ___ was at the same or higher salary level
1 ___ was at a lower salary level
2 ___ involved the same or higher occupational skills (technical skills)
3 ___ involved lower occupational skills (technical skills)
4 ___ work was interesting
5 ___ work was uninteresting
6 ___ involved the same type of work as I was doing before
7 ___ involved different type of work

6d. If YES to question 6b., did you accept the job offered?

46-0 ___ yes
1 ___ no

IF NO, please explain the reasons below:

47- ______________________________
____
____

7a. Was there any period of unemployment between the above-mentioned termination (during 1964) and your job following that termination?

48-0 ___ no
1 ___ yes

IF NO, SKIP TO QUESTION 10.

7b. If yes, how long did you remain unemployed?

49- ______________
(NUMBER OF WEEKS)

8a. If married, was your spouse employed during the above-mentioned period of unemployment?

50-0 ___ yes, full-time
1 ___ yes, part-time
2 ___ no

8b. Prior to the above-unemployment, was your spouse employed?

51-0 ___ yes, full-time
1 ___ yes, part-time
2 ___ no

9. During the period of your above stated unemployment, which of the following sources of financial support did you make use of? Please check in the space on the left hand side.

→ In the space below, please number (1,2,3) the three most important sources of support. Number 1 being most important.

52-0 ___	severance pay	53, 54, 55-0	___
1 ___	state unemployment insurance	1	___
2 ___	funds from pension plan and/or early retirement fund	2	___
3 ___	savings and liquidation of investments	3	___
4 ___	loans	4	___
5 ___	spouse's pay check	5	___
6 ___	income of other family members	6	___
7 ___	assistance from relatives and friends	7	___
8 ___	others, please specify: ___________	8	___

10. After your first (or only) termination during 1964, which of the following did you use when looking for a job? Please check in the space to the left those that apply.

→ Approximate below the number of job offers that you received from those you made use of.

56 ___	friends and personal contacts	___
57 ___	newspaper advertisements	___
58 ___	trade and professional magazines	___
59 ___	private employment agencies	___
60 ___	direct applications to various companies	___
61 ___	State of California - Department of Employment	___
62 ___	U. S. Government (Civil Service) representatives	___
63 ___	out-placement services offered by your previous employer	___
64 ___	services of professional societies	___
65 ___	others, please specify: ___________	___

11. Which of the above procured you the job that you accepted? Please indicate below.

66 ______________________________

12. To approximate, how many companies did you apply before you found your job after the first (or only) termination during 1964?

67 ______________
NUMBER OF JOB APPLICATIONS

13. How many of the above applications did you submit to companies located in each of the following regions of the United States?

	No. of Applications	Region
68	____________	San Francisco Bay Area
69	____________	State of California (outside of S.F. Bay Area)
70	____________	Pacific West (Wash., Oregon Alaska, Hawaii)
71	____________	Mountain West (Mont., Idaho Wyo., Colo., New Mex., Ariz., Utah, Nevada)
72	____________	South Atlantic (Delaware, Md., Dist. of Columbia, Va., N. Car., S. Car., Ga., Fla.)
73	____________	East South Central (Ky., Tenn., Ala., Miss.)
74	____________	West South Central (Ark., La., Okla., Texas)
75	____________	West North Central (Minn., Iowa, Mo., N. Da., S. Dak., Nebr., Kansas)
76	____________	East North Central Ohio, Ind., Ill., Mich., Wisc.)
77	____________	Middle Atlantic (N.Y., N.J., Penn.)
78	____________	New England (Maine, N.H., Vt., Mass., R.I., Conn.)
79	____________	Others, please specify:

14. Were any of the following factors helpful in obtaining the job after your first (or only) termination during 1964? Number (1,2) the two most helpful items in the order of importance, number 1 being the most helpful item. DO NOT CHECK MORE THAN TWO.

7,8-0 ____ willingness to relocate
1 ____ willingness to accept a cut in salary
2 ____ formal education and training
3 ____ industrial experience
4 ____ willingness to adjust to different type of work
5 ____ recommendations from friends
6 ____ others, please specify: ____________________
____

7 ____ nothing particularly helpful

10. Considering the total financial support that you received from the sources checked in the previous question, were these funds adequate to meet your needs?

DELETE

56-0 ____ adequate for maintaining normal standard of living.
1 ____ substantial, but had to curtail consumption somewhat
2 ____ able to make both ends meet, but had to curtail consumption considerably.
3 ____ inadequate
4 ____ extremely inadequate

15. Did any of the following factors make the search for a job, after your first (or only) termination during 1964, difficult? Please number (1,2) the two most pertinent items in the order of importance. Number 1 being the item which caused the maximum difficulty. DO NOT CHECK MORE THAN TWO.

9,
10-0 ____ inadequate and/or inappropriate formal education and training
1 ____ inadequate and/or inappropriate industrial experience
2 ____ too old
3 ____ too young
4 ____ too high a salary in my previous job
5 ____ lack of available jobs
6 ____ unemployed for too long a time (remained out of touch with industry too long)
7 ____ reluctant to move to a different geographical location.
8 ____ other, please specify: ________________
____
9 ____ none in particular

16. After your first (or only) termination during 1964, when looking for a job, did any of the following factors restrict your efforts towards obtaining a job? Please number (1,2,3) the three most pertinent items in order of importance. Number 1 being the most restrictive factor. DO NOT CHECK MORE THAN THREE.

11,
12,
13-0 ____ inability to sell the house
1 ____ inability to terminate the lease
2 ____ personal attachment to home
3 ____ thought of leaving an area offering greater cultural and educational opportunities
4 ____ reluctance to move away from relatives
5 ____ desire not to leave neighborhood friends
6 ____ not wishing to move children into new schools
7 ____ request from spouse not to change residence
8 ____ other ties, please specify: ______________
____
9 ____ nothing in particular

17a. After your first (or only) termination in 1964, where did you find a job?

14 ____
(NAME OF EMPLOYER) (CITY, STATE)

17b. If you had to move your household, who paid your moving expenses?

15-0 ____ the above company in full
1 ____ the above company in part
2 ____ myself
3 ____ others, please specify: ______________
____

18a. Is (was) your work at the company mentioned in question #17a predominantly:

16-0 ____ defense-oriented (under government defense contract or subcontract)
1 ____ non-defense

18b. Is (was) your work at the company in question #17a different from what you were doing prior to your first (or only) termination in 1964?

17-0 ____ no
1 ____ yes

18c. If YES, in what way is (was) it different? Please explain:

18- ____
____
____

19. What is (was) your approximate yearly salary (before taxes) at the company mentioned in question #17?

19-0 ____ over $21,000
1 ____ between $18,000 and $21,000
2 ____ $15,000 and $17,999
3 ____ $12,000 and $14,999
4 ____ $10,000 and $11,999
5 ____ $8,000 and $9,999
6 ____ $6,000 and $7,999
7 ____ less than $6,000

20a. Have you changed your job since you joined the company mentioned in question #17a?

20-0 ____ no
1 ____ yes

IF NO, SKIP TO SECTION C

20b. If YES, how many times?

21 ________________________________
(NUMBER OF JOB CHANGES)

21. Please list below all the jobs that you held since the one mentioned in question #17a.

JOB IMMEDIATELY AFTER THE ONE IN QUESTION #17a.

22 ____
(NAME OF EMPLOYER) (CITY, STATE)

____________________ ____________________
(FROM: MONTH, YEAR) (TO: MONTH, YEAR)

23 ____
(TYPE OF WORK, PREDOMINATELY DEFENSE – INCLUDING SUBCONTRACT – OR NON-DEFENSE)

24 ________________________
(APPROXIMATE YEARLY SALARY)

JOB AFTER THE ONE GIVEN ABOVE

25 ____
(NAME OF EMPLOYER) (CITY, STATE)

____________________ ____________________
(FROM: MONTH, YEAR) (TO: MONTH, YEAR)

26 ____
(TYPE OF WORK, PREDOMINANTLY DEFENSE – INCLUDING SUBCONTRACT – OR NON-DEFENSE)

27 ________________________
(APPROXIMATE YEARLY SALARY)

IF YOU CHANGED JOBS MORE THAN TWICE, PLEASE GIVE ADDITIONAL SIMILAR INFORMATION ON A SEPARATE SHEET

SECTION C

JOB HISTORY

INSTRUCTIONS: THE QUESTIONS IN THIS SECTION CONCERN ALL FULL-TIME JOBS THAT YOU HELD BETWEEN JANUARY 1961 AND DECEMBER 1963

1. How many times did you change your job between January 1961 and December 1963?

28 ________________________________
(NUMBER OF JOB CHANGES)

2. If you had to move when relocating jobs (during Jan. '61 - Dec. '63), who paid your moving expenses?

29 ____ various companies ____________ (NO. OF TIMES)

30 ____ myself ____________ (NO. OF TIMES)

31 ____ others, please specify: ____________ (NO. OF TIMES)

3. What were the three main reasons which motivated you to change jobs during January 1961 – December 1963?
DO NOT CHECK MORE THAN THREE.

32-0 ____ higher salary
1 ____ more interesting work
2 ____ better geographical location
3 ____ job security
4 ____ better working conditions
5 ____ location near relatives and/or close friends
6 ____ better cultural and educational opportunities
7 ____ opportunity for advancement
8 ____ desire to change
9 ____ shorter commuting distance

33-0 ____ laid off for lack of work
1 ____ dismissed
2 ____ others, please specify: ____
____

4. Please list below all the jobs that you held between January 1961 and December 1963 in chronological order, beginning with the earliest job.

YOUR JOB IN JANUARY 1961:

34 ____ (NAME OF EMPLOYER) ____ (CITY, STATE)
____ (FROM: MONTH, YEAR) ____ (TO: MONTH, YEAR)

35 ____ (TYPE OF WORK, PREDOMINANTLY DEFENSE - INCLUDING SUBCONTRACT -- OR NON-DEFENSE)

36 ____ (APPROXIMATE YEARLY SALARY)

37 ____ (REASONS FOR TERMINATING)

YOUR NEXT JOB:

38 ____ (NAME OF EMPLOYER) ____ (CITY, STATE)
____ (FROM: MONTH, YEAR) ____ (TO: MONTH, YEAR)

39 ____ (TYPE OF WORK, PREDOMINANTLY DEFENSE – INCLUDING SUBCONTRACT – OR NON-DEFENSE)

40 ____ (APPROXIMATE YEARLY SALARY)

41 ____ (REASONS FOR TERMINATING)

YOUR NEXT JOB:

42 ____ (NAME OF EMPLOYER) ____ (CITY, STATE)
____ (FROM: MONTH, YEAR) ____ (TO: MONTH, YEAR)

43 ____ (TYPE OF WORK, PREDOMINANTLY DEFENSE – INCLUDING SUBCONTRACT – OR NON-DEFENSE)

44 ____ (APPROXIMATE YEARLY SALARY)

45 ____ (REASONS FOR TERMINATING)

SECTION D

GENERAL INFORMATION

1a. What is your marital status?

50-0 ____ married
1 ____ widower/widow
2 ____ divorced
3 ____ single (never married)

1b. What is your sex:

51-0 ____ male
1 ____ female

1c. What is your age?

52 ____ (NUMBER OF YEARS)

IF SINGLE (NEVER MARRIED), SKIP TO QUESTION NO. 3

2a. How many dependent children do you have?

53 ____ (NUMBER OF CHILDREN)

2b. How many other dependents (excluding your spouse) do you support?

54 ____ (NUMBER OF OTHER DEPENDENTS)

3a. If single (never married), do you have any dependents?

55-0 ____ yes
1 ____ no

3b. If yes, how many?

56 ____ (NUMBER OF DEPENDENTS)

4. How many scientific and technical magazines do you read regularly?

57 ____ (NUMBER OF MAGAZINES)

5. If you are a member of any technical or scientific professional society, such as The Institute of Electrical and Electronic Engineers, National Society of Professional Engineers, etc., please indicate it below.

58 ____ (NAMES OF PROFESSIONAL SOCIETIES)
____ (NAMES OF PROFESSIONAL SOCIETIES)
____ (NAMES OF PROFESSIONAL SOCIETIES)

a. Do you belong to any honor society such as Tau Beta Pi, Sigma Xi, etc.?

59-0 ____ yes
1 ____ no

b. If yes to #6a, please list the names of the ocieties.

60 ____________________
(NAMES OF HONOR SOCIETIES)

____
(NAMES OF HONOR SOCIETIES)

____
(NAMES OF HONOR SOCIETIES)

7a. Have you had any patent issued in your name?

61-0 ____ yes
1 ____ no

7b. If yes, how many?

62 ____________________
(NUMBER OF PATENTS)

8a. Have you published any technical or scientific article in a magazine of national circulation?

63-0 ____ yes
1 ____ no

8b. If yes, how many?

64 ____________________
(NUMBER OF PUBLICATIONS)

. Is there anything else that you would like us to now regarding your termination and re-employment xperiences during 1964-65?

10. Do you have any comments concerning engineering and scientific employment and defense cutbacks? If so, please write in the space below.

11. On the basis of your personal experiences, would you like to make suggestions for improving (a) re-employment processes, (b) public assistance programs, and (c) utilization of engineers and scientists? Please write in the space below.

Thank you for your co-operation.

R. P. Loomba
San Jose State College

APPENDIX B

QUESTIONNAIRES MAILED TO 104 LARGEST DEFENSE AND NON-DEFENSE COMPANIES LOCATED IN THE SEVEN COUNTIES OF THE SAN FRANCISCO BAY AREA

B.1 Data Form No. 2

B.2 Data Form No. 3

B.3 Response Rate = 77 percent

Note: It is estimated that the 80 firms which responded employ 90 percent of all the aerospace and electronics engineers in the San Francisco Bay Area.

SAN JOSE STATE COLLEGE
SAN JOSE, CALIFORNIA

ENGINEERING MANPOWER RESEARCH PROJECT

DATA FORM NO. 2

	Total Number of Employees (blue and white collar)	Total Number of Engineers and Scientists
1) 1 January 1963		
2) 1 January 1964		
3) 1 January 1965		
4) 31 May 1965		

5) Name and address of the company ____________________

____

6) Name of the person who furnished the information:

____
(last) (first) (middle)

____
(title)

____
(signature)

7) Date ____________________

SAN JOSE STATE COLLEGE
SAN JOSE, CALIFORNIA

ENGINEERING MANPOWER RESEARCH PROJECT

DATA FORM NO. 3

	Total Number of Employees (blue and white collar)	Total Number of Engineers and Scientists
1 January 1966		
30 April 1966		

Name and address of the company ____________________

____

Name of the person who furnished the information:

____
(last) (first) (middle)

____
(title)

____
(signature)

Date: ____________________

APPENDIX C

SOURCES OF LAYOFF DATA

C.1 Names of Newspapers

1. The San Francisco Chronicle
2. The Palo Alto Times
3. The Sacramento Union
4. The Los Angeles Times
5. The Seattle Times
6. The Boston Globe
7. The Philadelphia Inquirer
8. The Washington Post
9. The Saint Louis Post Dispatch
10. The New York Times
11. The Wall Street Journal
12. The Denver Post

C.2 Names of Magazines

1. The Aviation Week
2. American Engineer
3. Chemical Engineer
4. Electronics
5. Electronic Design News
6. Electronic News
7. Electronic Industries
8. Electronic World
9. International Science and Technology
10. Machine Design
11. Rockets and Missiles
12. Space/Aeronautics
13. Business World
14. Business Week
15. Saturday Evening Post
16. Harvard Business Review

C.3 Pertinent Surveys

1. Conducted by: Aerospace Industries Association

Date: April 1964

Sample: 55 companies employing approximately 70 percent of the total 1.25 million defense workers.

Results: During the 6-month period ending March 31, 1964, 28,496 defense workers were laid off. Predicted than an additional 28,786 individuals would be laid off during the 6-month period ending September 30, 1964.

2. Conducted by: Professor Seymour Melman, Columbia University

Date: April 1964

Sample: 19 major defense firms located in California, Colorado, Massachusetts, New Jersey, New York, and Washington.

Results: During the 15-month period ending March 31, 1964, approximately 67,000 defense employees had either lost their jobs or were awaiting job losses.

3. Conducted by: California State Department of Employment

Date: September 1964

Sample: Aerospace and electronics employers in the San Francisco Bay Area

Results: Approximately 5,000 job losses occurred in the 9-month period ending September 1964. Predicted that an additional 5,000 individuals would be laid off in the 6-month period ending March 31, 1965.

APPENDIX D

STATES INCLUDED WITHIN EACH GEOGRAPHICAL REGION

REGION	STATES
Pacific West	Washington, Oregon, Alaska, Hawaii
Mountain West	Montana, Idaho, Wyoming, Colorado, New Mexico, Arizona, Utah, Nevada
South Atlantic	Delaware, Maryland, District of Columbia, West Virginia, Virginia, North Carolina, South Carolina, Georgia, Florida
East South Central	Kentucky, Tennessee, Alabama, Mississippi
West South Central	Arkansas, Louisiana, Oklahoma, Texas
West North Central	Minnesota, Iowa, Missouri, North Dakota, South Dakota, Nebraska, Kansas
East North Central	Ohio, Indiana, Illinois, Michigan, Wisconsin
Middle Atlantic	New York, New Jersey, Pennsylvania
New England	Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut

(The state of California was coded separately)